MACHINERY

VOLUME 57 **JANUARY, 1951** NUMBER 5

The Monthly Magazine of Engineering and Production in the Manufacture of Metal Products

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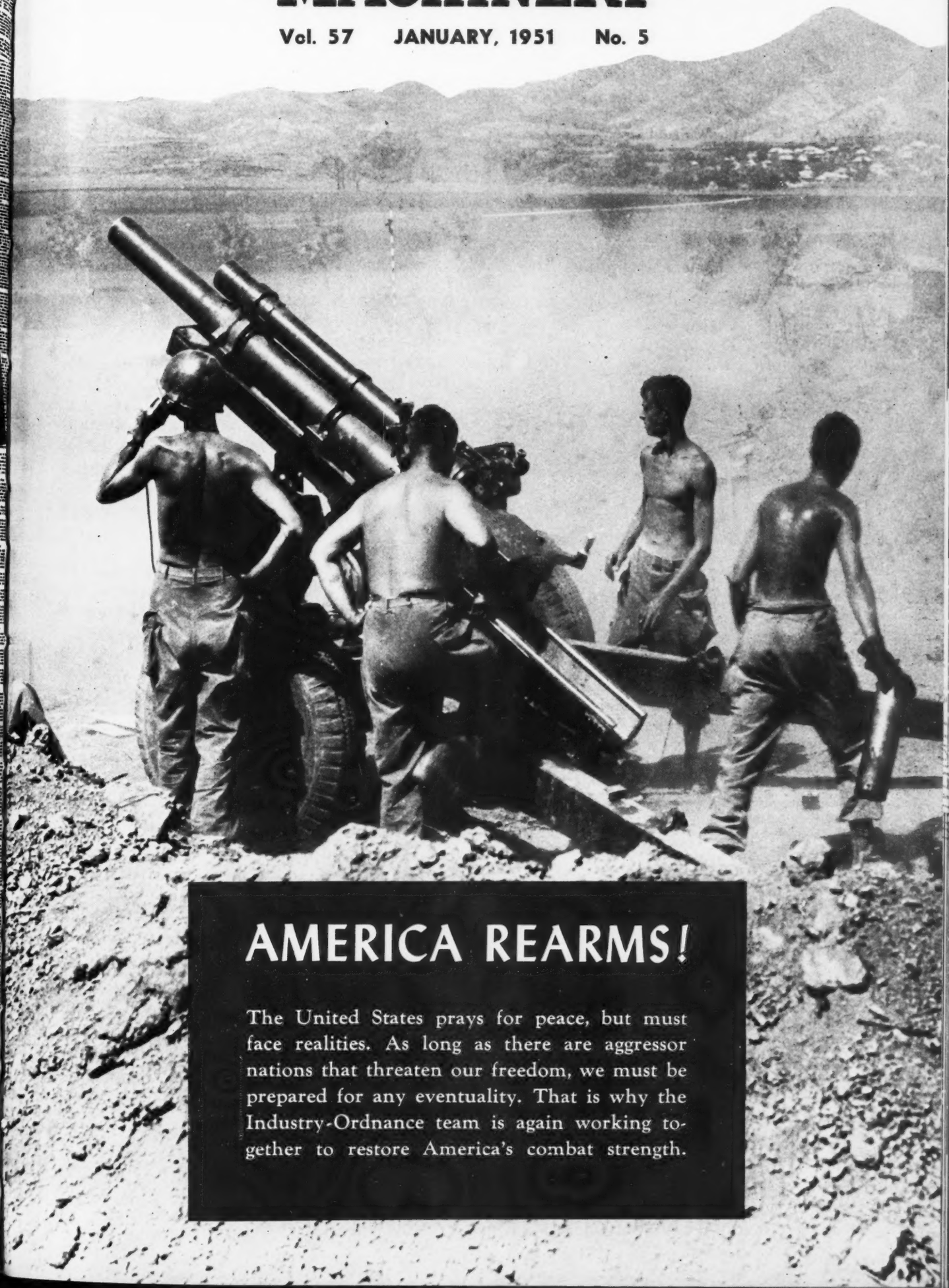


AMERICA REARMS!

The United States prays for peace, but must face realities. As long as there are aggressor nations that threaten our freedom, we must be prepared for any eventuality. That is why the Industry-Ordnance team is again working together to restore America's combat strength.

BRIGADIER GENERAL E. L. CUMMINGS

SUPERIOR

DURING World War II, approximately 295,000 American fighting men lost their lives, but they exacted a toll of 1,000,000 of the enemy forces opposing the United States in the various theaters of operation. Superior ordnance in vast quantities in the hands of well trained men was the main reason for this large ratio in our favor, since when the chips are down in any modern war, it is the fighting power of our planes, tanks, artillery, mortars, rifles, and ammunition that accounts for victory or defeat on the field of battle.

In the interim since World War II, the Ordnance Corps of the U. S. Army has not been idle. With the cooperation of industry, our scientists and engineers have been vigorously engaged in improving and modernizing all types of equipment. In every instance possible, the lessons learned in actual fighting have been applied to their endeavors. These improvements in fighting equipment have been supplemented by research and development activities which are still secret.

We are constantly attempting to provide our fighting men with the best equipment in the world, and our improved materiel was in a good measure responsible for the success of our troops in Korea. The Ordnance Corps can only develop the world's finest war equipment; it does not have the facilities for producing in the quantities

A bazooka team in action against Communist positions in North Korea

ORDNANCE SAVES LIVES

By Brigadier General E. L. CUMMINGS
Chief, Industrial Division
Ordnance Corps, U. S. Army

necessary to meet World War emergencies—that is the job of American industry, and the Ordnance Corps has faith that the greatest industrial nation in the world can turn out materials in quantities more than enough to defeat any aggressor. We all pray for peace, but we must be ready if war is thrust upon us.

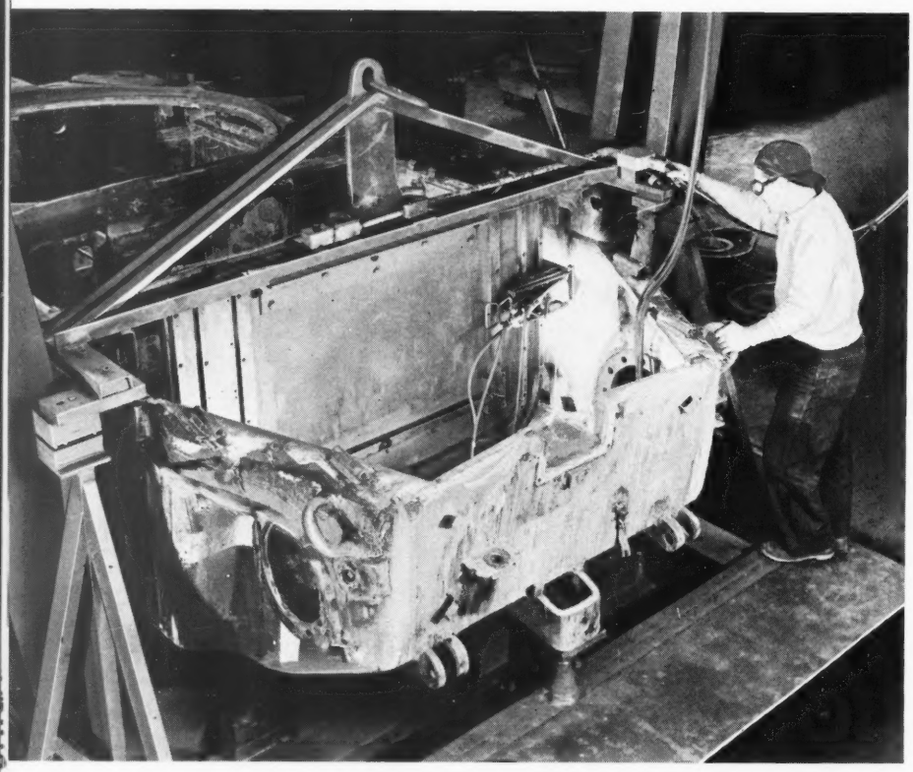
Industry is already engaged in America's rearmament program, as indicated by the Ordnance Production articles presented in this number of MACHINERY, which features the manufacturing methods in plants of some of our important contractors. Output is most gratifying, but it is only a trickle in comparison with present defense plans. A total of $10,214,200,000 has been appropriated by Congress for fighting materiel for the Armed Forces, of which approximately $1,515,000,000 will be expended in 1951 by Army Ordnance. That means large orders for more industrial concerns.

As always, when the nation prepares for military defense, machine tools become of paramount importance, because the production of Ordnance is primarily dependent upon that class of machines. At the beginning of World War II, machine tools were a bottleneck, for the machine tool industry of that day did not have production facilities commensurate with the huge job suddenly thrust upon it. Now the Ordnance Corps has an appreciable reserve of machine tools which were placed in storage after World War II and which have been maintained in serviceable condition for practically immediate use when the occasion demands. However, this reserve represents a small percentage of our probable needs. Today, according to statistics, the manufacturing facilities of the machine tool industry are about three times as great as they were before the last war, and it is hoped that machine tool builders will be able to meet the increased demand for their products without a serious hold-up of defense programs.

Industry and Army Ordnance have always cooperated in excellent fashion—perhaps because Ordnance personnel consists mainly of engineers —and they understand each other's problems. The cordial relations of the past are indicative of the future. The Industry-Ordnance team will again, if needed, turn out the massive quantities of superior ordnance that saves lives.

M-26 tanks making an under-water crossing of the Kumho River in Korea

PATTON TANKS



Combat-Proven 47-Ton Patton Tanks are being Produced from Lighter and Slower Pershing Tanks, and M-24 Tanks are being Overhauled at the Famous Detroit Arsenal. Some of the Unusual Methods Employed in This Major Rearmament Effort are Described Here

By CHARLES H. WICK

Fig. 1. A special flame-cutting machine is employed for burning through thick armor plate in order to remove a long section from the rear of the old tank hulls

VALUABLE experience gained in the Korean war has proved the worth of the powerful new 47-ton General Patton M-46 medium tank. Weighing 7 tons more than the Pershing, this tank is faster and more maneuverable. The Patton tank, seen in the illustration on the opposite page, is powered by a new twelve-cylinder, air-cooled Continental engine. Its revolving turret is equipped with an improved 90-millimeter high-velocity gun.

Pershing tanks are being taken from storage depots and cleaned, dismantled, and completely rebuilt into Patton tanks at the famous Detroit Arsenal. As part of the rearmament effort, the arsenal is also completely overhauling M-24 light tanks. Built in 1941 and operated during World War II by Chrysler Corporation for the United States Army, the arsenal is now a part of the arsenal system that is operated by the Ordnance Corps.

The Detroit Arsenal is believed to be the largest in the world completely devoted to tank production. It contains more than 700,000 square feet of floor space and over 1000 machine tools. Today, two production lines are in operation, one for the overhauling of M-24 light tanks and the other for the conversion of the Pershing to the Patton tanks. After a complete inspection and rigid operational test on the huge road test track adjacent to the shop, the tanks are loaded on flat cars and shipped to training camps or areas in which democracy is being threatened.

After the steam-cleaning and dismantling of the Pershing tanks, a long section is flame-cut from the rear end of the tank hull. This is done in order that a new, longer casting, which will accommodate the larger, more powerful engine, can be welded to the hull. The flame-cutting operation is a particularly difficult one, because it is necessary to sever armor plate of varying thicknesses. It is accomplished by means of a special flame-cutting machine equipped with the work-fixture seen in Fig. 1.

The fixture is provided with four locating plugs which enter the bores in the suspension support arms on the tank hull. Both horizontal and vertical adjustment is possible before the hull is clamped in place. A reinforcement bar

ROLL FROM DETROIT ARSENAL

is spread between the sides of the tank hull to minimize distortion during cutting.

The flame-cutting machine is hoisted from a storage rack, lowered inside the hull against an established locating point, and secured. This machine consists essentially of a vertical plate on which are mounted a shaped rack and track for guiding two oxy-acetylene flame-cutting torches through the desired path. The torches are fed by a variable-speed motor-driven gear which meshes with the rack mounted on the vertical plate.

Less than a half hour is required to burn through the armor plate at the rear of the tank hull. When the scrap end of the tank hull has been removed, the torches are adjusted to form an angle of 45 degrees with the sides of the remaining hull. Scarfing angles are then flame-cut on the burned through edges of the tank hull. Considering the time required for loading, locating, clamping, flame-cutting, adjusting, scarfing, and unloading, each tank hull is completed in a remarkably short time.

New rear-end castings are tack-welded to the cut-off hulls by a series of short welds along the adjoining surfaces. Welding of the assembly is completed in large rotating fixtures such as the one shown in Fig. 2. Four of these fixtures are provided to meet the required production. One operator completes the joining of the rear casting and hull by welding on the outside, while another operator welds on the inside. During these operations, a third welder performs a total of fifty-eight operations in adding numerous brackets, pads, nuts, and clips to the interior of the tank hull.

A double-vee, 45-degree, butt groove is provided for butt-welding the hull to the rear casting. At the apex of the vees, a flat 1/8 inch wide is produced, and the flats on the hull and rear casting are spaced about 3/8 inch apart. For the thicker sections of armor plate, over seventy passes are necessary. First, weave passes are made, using 3/16-inch diameter electrodes at about 160 amperes and 22 volts. Then, four

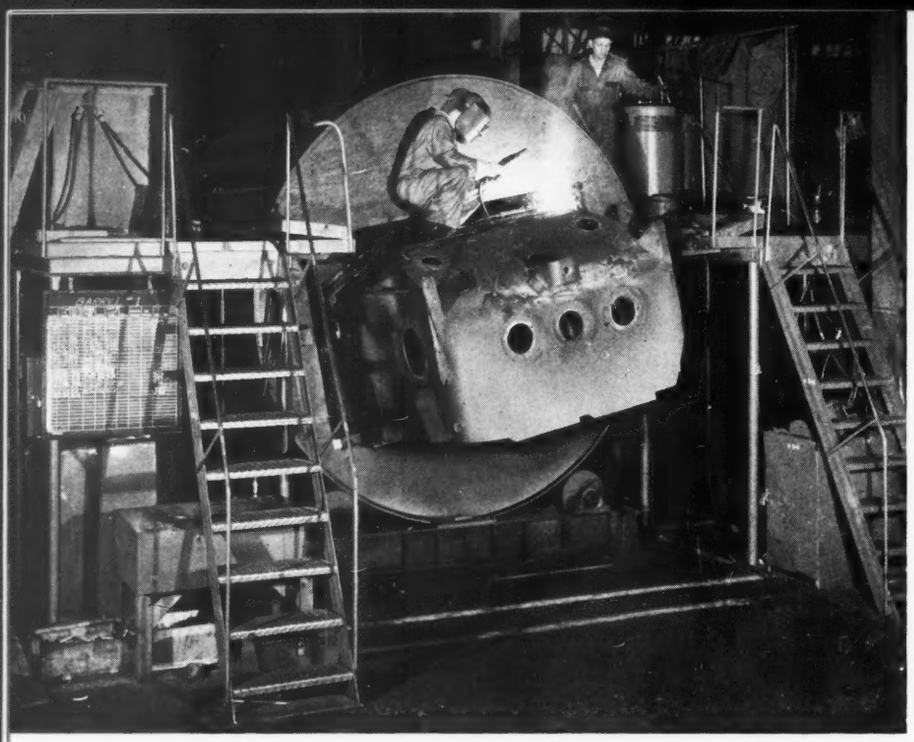


Fig. 2. New, longer rear-end castings are joined to the cut-off tank hulls on a huge rotary welding fixture. Over seventy passes are required in welding the thicker sections

stringer passes are completed with the same size electrodes and current characteristics. Finally, approximately twenty weave passes are made with 5/16-inch diameter electrodes at about 300 amperes and 28 volts. Grade 307 or 308 electrodes and 600-ampere arc-welding machines are employed for these operations. Welding is performed at a rate of approximately 5 inches per minute.

Bolt-holes for the main-drive gear assembly are drilled through the tank hull by means of the set-up illustrated in Fig. 3. The hull is located and clamped in a special fixture, and the 1 1/32-inch diameter holes are drilled with a Natco horizontal, way type drilling unit. After drilling the holes through one side, the hull is swung through an angle of 180 degrees in the horizontal plane, and the opposite side is drilled with the same unit.

Many new and replacement parts are required in transforming the M-26 tanks into the heavier, more powerful Patton tanks and in overhauling the M-24 light tanks. Some of the more unusual machining methods employed in producing such parts will now be described.

Front-wheel support arms for the General Patton tank are forged from an alloy steel. The forgings have a high Brinell hardness, and are milled and bored to close dimensional accuracy on the machines seen in Figs. 4 and 5. In the first operation, performed on a Cincinnati four-spindle Hydro-Tel milling machine (Fig. 4), the three hubs are faced square with their respective bores and parallel with each other within

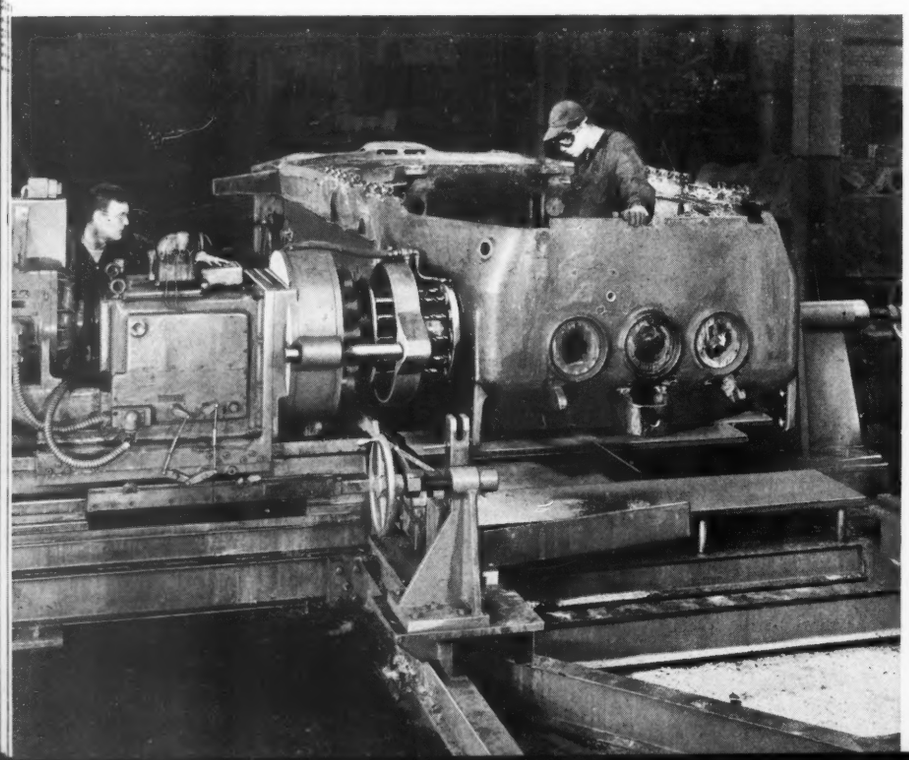


Fig. 3. A special tank-hull fixture equipped with a multiple-spindle drilling head is employed for drilling 1 1/32-inch diameter bolt-holes for main-drive gear assembly

Fig. 4. Three hubs on the forged-steel, front-wheel support arms for the Patton tank are faced on this milling machine. Cutters are guided by a duplicating device

± 0.0015 inch. The vertical distances between the three hub or boss faces are maintained within ± 0.001 inch.

From 3/16 to 1/4 inch of stock is removed from each of the bosses in one pass, using 8-, 9-, and 10-inch diameter face mills on the vertical spindles of the machine. The milling cutters are provided with Firthite Grade T-83X, tungsten-carbide tipped blades having a negative radial rake angle of 7 degrees. All three cutters are rotated at 325 R.P.M. and fed at the rate of 2 1/2 inches per minute. The cutters are electrically guided in their angular path across the work by a templet and a 1 3/8-inch diameter tracer roll, seen below the operator's right hand. The time required for completing this operation on the forged support arm is less than a half hour.

Five holes in the front-wheel support arm are semi-finish- and finish-bored, two holes are chamfered, and one hole is counterbored on the Moline six-spindle, five-station vertical boring machine shown in Fig. 5. Three support arms are machined simultaneously, and the work-holding fixtures are moved from station to station. Spacing of the various holes is held to ± 0.0025 inch, while the diameters are maintained within ± 0.001 inch.

The support arm is located and clamped in a fixture at the first station, seen at the right-hand end of the machine. At the second station, two holes previously core-drilled to 2 1/4 inches in diameter are finish-bored to diameters of 2.337 and 2.439 inches, respectively. On a second spindle at the same station, tools are provided in a

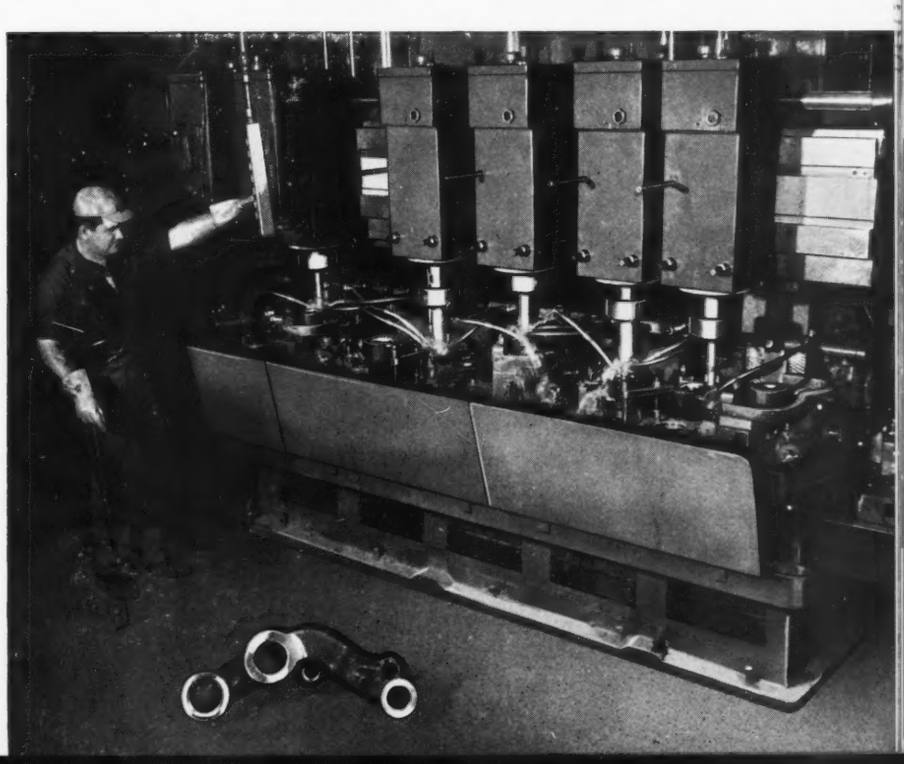


Fig. 5. Six-spindle, five-station vertical boring machine used for semi-finish- and finish-boring, chamfering, and counterboring holes in tank front-wheel support arms

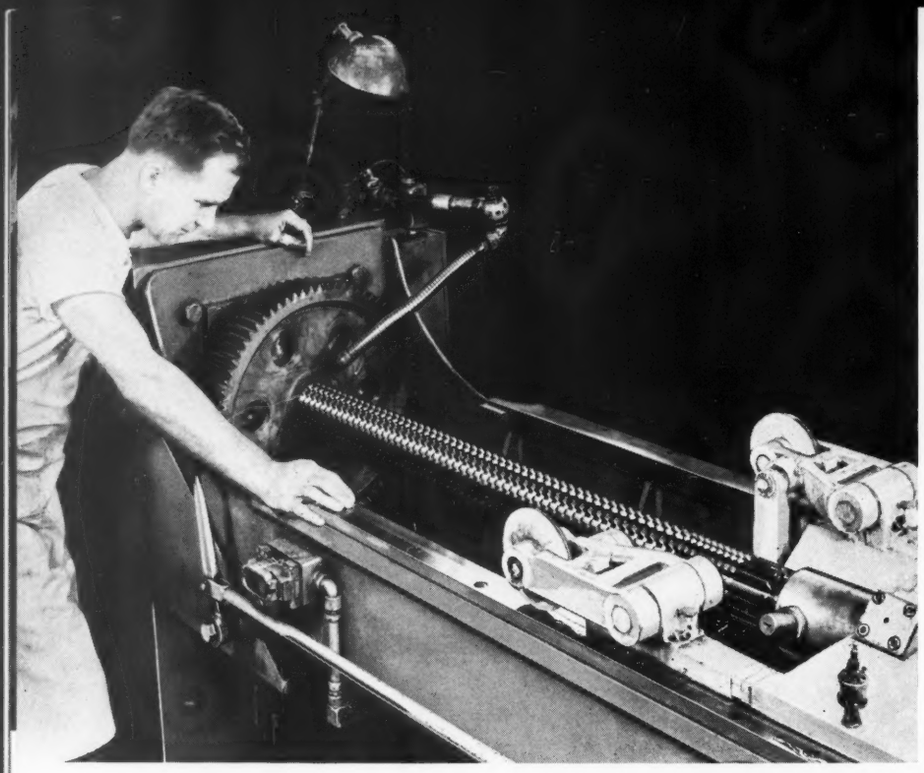


Fig. 6. A fifty-ton, horizontal pull type broaching machine is employed to rough- and finish-form the equally spaced splines in the bore of the final-drive gear

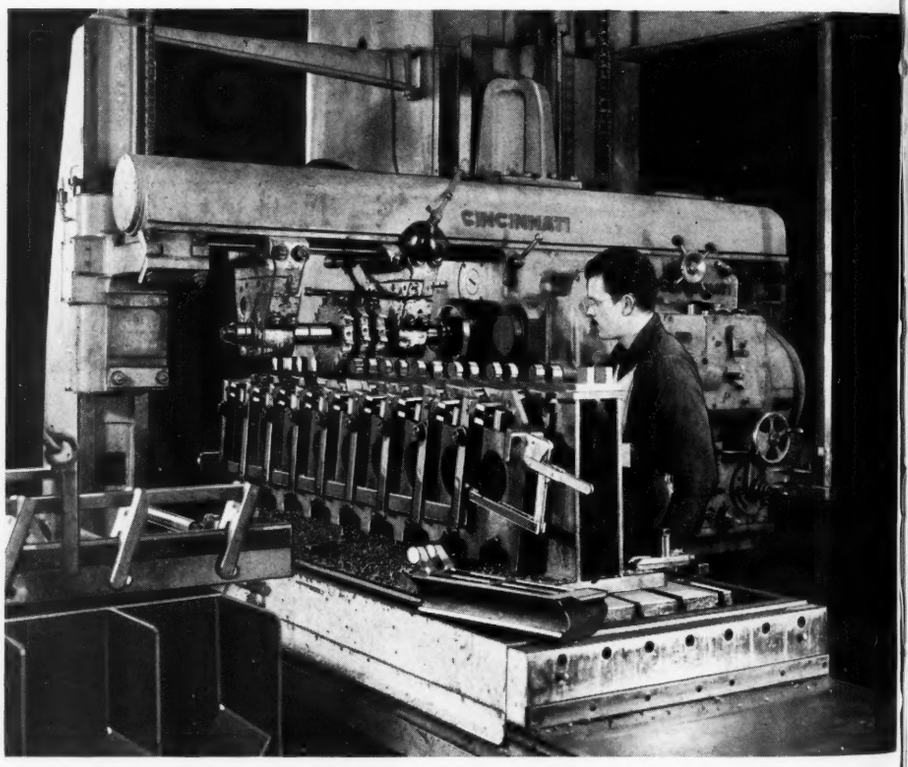


Fig. 7. Four surfaces on each of nine cast armor-steel grille doors are straddle-milled in this set-up. The distance between the milled surfaces is held to a tolerance of plus or minus 0.001 inch

boring-bar to semi-finish a 4 1/4-inch drilled hole to a diameter of 4.440 inches, and finish-bore the same hole to a diameter of 4.4985 inches. A 3/8-inch by 55-degree chamfer is also machined at this station.

At the third station, a drilled hole 4 1/2 inches in diameter is semi-finish- and finish-bored and chamfered. A third hole core-drilled to a diameter of 2 1/4 inches is semi-finish- and finish-bored at the fourth station. The completed support arm is unloaded at the fifth station, after which the empty fixture is returned to the first station.

Carboloy Grade 44A, tungsten-carbide block cutters are provided on the boring-bars. The bars are rotated at a speed of 182 R.P.M., with a feed of 0.008 inch per revolution.

Splines in the bore of the tank transmission final-drive gear are rough- and finish-broached by means of the set-up illustrated in Fig. 6. An

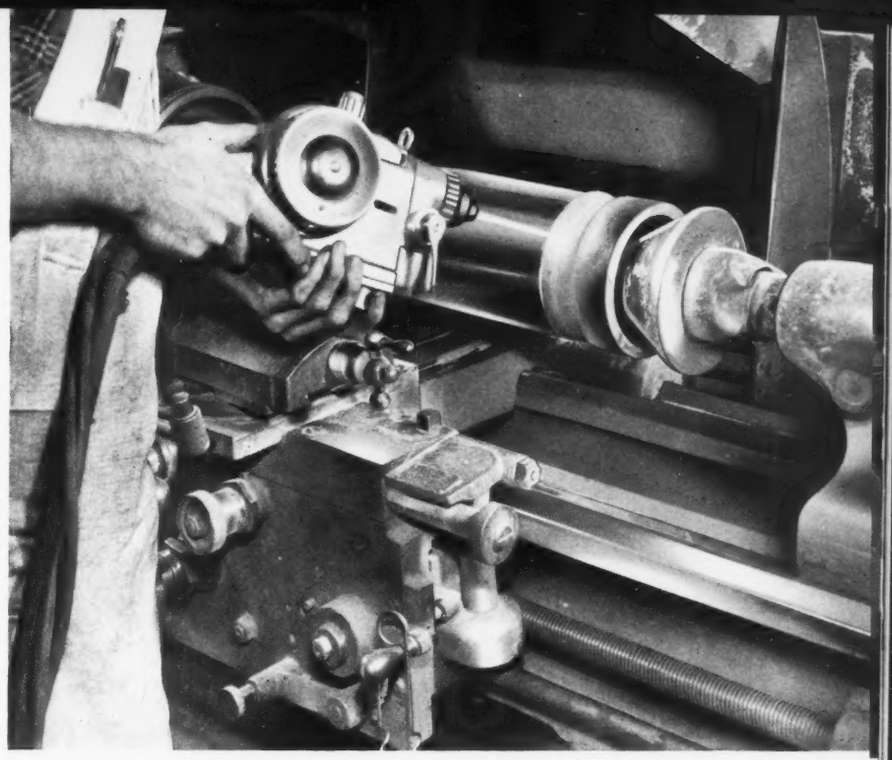


Fig. 8. Wearing surfaces on the recoil-cylinder support assembly for 75-millimeter tank guns are coated with bronze by metal spraying to minimize scoring when the gun recoils

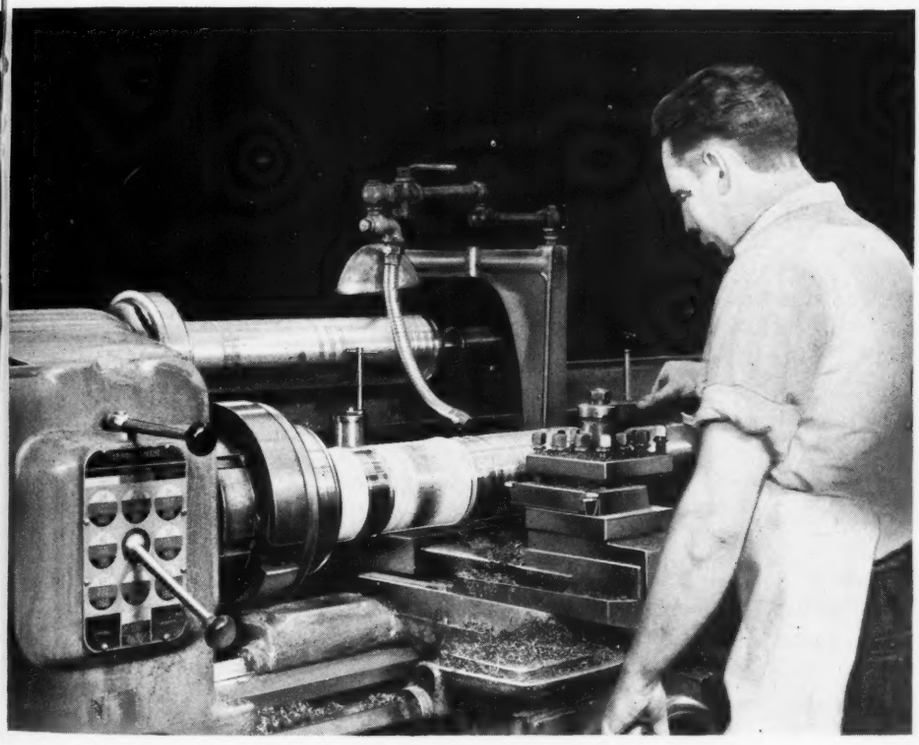


Fig. 9. Hydraulic shaft-duplicating lathe in which a finish-turned cylinder support assembly is employed as a templet to guide the tools in turning five different surfaces on the work

Oilgear 50-ton, horizontal pull type broaching machine is employed for these operations. The bore diameter formed by the splines must be maintained within ± 0.001 inch, and this diameter must also be concentric with the hub diameter on the gear within 0.002 inch total indicator reading.

The final-drive gear, which is forged from a low-carbon alloy steel, is located in the broaching fixture by means of its previously machined hub. In rough-broaching, the root diameter of the splines is held to a specific depth, which is increased about 1/4 inch during finish-broaching. The long broaches are pulled through the gears at the rate of 7 feet per minute. Both rough- and finish-broaching of the splines in each gear are completed in less than a half hour.

Twenty-four cast armor-steel grille doors are mounted on the top deck of the Patton medium tank. One end of each door is provided with two hinge lugs, which are straddle-milled on the Cincinnati horizontal, bed type milling machine

Fig. 10. Modified square threads having a major diameter of about 9 inches are ground from the solid on the large-diameter ends of recoil-cylinder support assemblies

shown in Fig. 7. Four surfaces are machined on nine castings in one set-up. The rough castings are set on end, with their hinged ends up, in a holding rack, part of which may be seen at the lower left of the illustration. A special lifting fixture containing a pair of pins for grasping the hinge lugs on each casting is placed over the castings. The work is secured in the fixture by simply pulling one toggle-clamp lever.

The fixture, with its load of nine castings, is lifted by means of a hoist over the milling machine table and the parts are lowered into the work-fixture. The empty lifting fixture is then returned to the holding rack, and the castings are secured in the work-fixture. Only one nut has to be tightened, and one toggle-clamp lever pulled to secure all nine castings for the milling operation.

Three staggered-tooth carbide-tipped face milling cutters, 10 inches in diameter, are accurately spaced on the milling machine arbor. The space between the lugs on each casting is milled to a $\pm$ 0.001-inch tolerance, while the distance over the lugs is maintained within $\pm$ 0.0015 inch. The three cutters are sharpened in sets to insure holding this accuracy. Using a cutter speed of 25 R.P.M. and a feed of 0.010 inch per revolution, all nine castings are completely machined in about twenty-five minutes.

Bearing surfaces on the recoil-cylinder support assembly for the 75-millimeter guns used on light tanks are particularly subject to scoring when the gun recoils after firing. Originally, bronze inserts were employed for such wearing surfaces. This proved an expensive method of manufacturing, and was not too satisfactory. Then bronze welding was tried, but with this method, the cylinder support assemblies were badly distorted. Good results are now being obtained at relatively low cost by metal spraying, as seen in Fig. 8. In spraying molten bronze on the wearing surfaces of the part, an operating temperature of less than 200 degrees F. is required. Distortion is therefore eliminated.

Preparatory to the metal-spraying operation, the entire cylinder support assembly is cleaned by vapor degreasing, and the areas to be sprayed are grit-blasted to roughen the surfaces. The assembly is then mounted between centers on a standard Bradford lathe as shown, and the wearing surfaces are preheated to a given temperature between 100 and 125 degrees F. by directing an oxy-acetylene flame on the rotating part.

A molybdenum alloy bonding under coat is then sprayed to a thickness of about 0.003 inch on the wearing surfaces of the cylinder support assembly. In this operation, Sprabond 1/8-inch diameter wire (made by the Metallizing Engineering Co.) is fed continuously through the nozzle of a Metco spray gun into a gas-oxygen flame that is introduced at high pressure through ports drilled in the nozzle. As the wire melts, blasts of compressed air carry the molten metal on the surfaces to be coated. The molybdenum alloy adheres molecularly to the sand-blasted surfaces of the work and presents a good bonding surface for subsequent spraying on of the bronze coating.

Following the application of the under coat, the wearing surfaces are again preheated, after which bronze wire, 1/8 inch diameter, is sprayed on them. A thickness of about 0.005 inch is ap-

Fig. 11. Road-wheel hubs are faced, turned, bored, chamfered, and drilled, on this eight-spindle Mult-Au-Matic. A rough forging is seen at the left and a completed hub at the right

plied to the successive surfaces as the gun is traversed from one end of the work to the other. This procedure is repeated until a total of approximately 9 pounds of bronze has been deposited on the part. The work rotates at 50 surface feet per minute, and approximately thirty-five minutes is required to complete each cylinder support assembly. The metal-spraying operation must be completed without lengthy interruptions to avoid excessive cooling and separation of the metal layers applied to the work.

Three of the bronze areas on the cylinder support assembly are turned within a tolerance of ± 0.001 inch on an American hydraulic shaft-duplicating lathe, Fig. 9. In the same operation, two steel sections are turned to a tolerance of ± 0.001 inch.

A finish-turned cylinder support assembly is used as the templet to reproduce these diameters accurately with a single-point, carbide-tipped cutting tool. The templet is held between centers at the rear of the lathe, and a stylus is kept in contact with it by hydraulic pressure. As the stylus is fed across the templet, it automatically controls the movement of the cutting tool. The cylinder support assembly to be machined is rotated at 318 R.P.M., and the stylus and cutting tool are fed 0.0038 inch per revolution when turning the bronze surfaces, and 0.012 inch per revolution when turning the steel sections.

Modified square threads are ground from the solid on the large-diameter end of the recoil-cylinder support assembly. These special external threads have a major diameter of approximately 9 inches, and there are ten threads per inch. The operation is performed on an Ex-Cell-O thread grinding machine, as seen in Fig. 10. A work speed of 6 R.P.M. and a wheel speed of 2050 R.P.M. are employed. The production rate on this operation averages one cylinder support assembly per hour.

Typical of the many tank parts produced on Bullard eight-spindle Mult-Au-Matics is the road-wheel hub. The hubs, forged from an alloy steel, are faced, turned, bored, chamfered, and drilled on one of these machines at the rate of fifteen per hour. A rough forging and a finish-machined part are shown side by side at the front of the machine in Fig. 11.

At the first station, the road-wheel hub forging is loaded in the chucking fixture. When the forging has been indexed to the second station, the maximum diameter is semi-finish-turned to about 13 inches, a 9-inch diameter shoulder is semi-finish-turned, and the center hole is rough-bored to 4.050 inches. The work is rotated at 148 surface feet per minute, and the tools are fed at the rate of 0.0105 inch per revolution.

At the third station, the flange faces are semi-finished at a surface speed of 168 feet per minute with a tool feed of 0.015 inch per revolution. The flange faces and top face of the forging are finished at the fourth station. Here the work speed is increased to 200 feet per minute and the feed is reduced to 0.0127 inch per revolution.

The center hole is semi-finish-bored and the maximum diameter of the road-wheel hub is finish-turned and chamfered at the fifth station. The tools at this station are fed 0.0079 inch per revolution while the work is rotated at 190 feet per minute. The bore is finished within a tolerance of ± 0.0005 inch by reaming, and the 9-inch

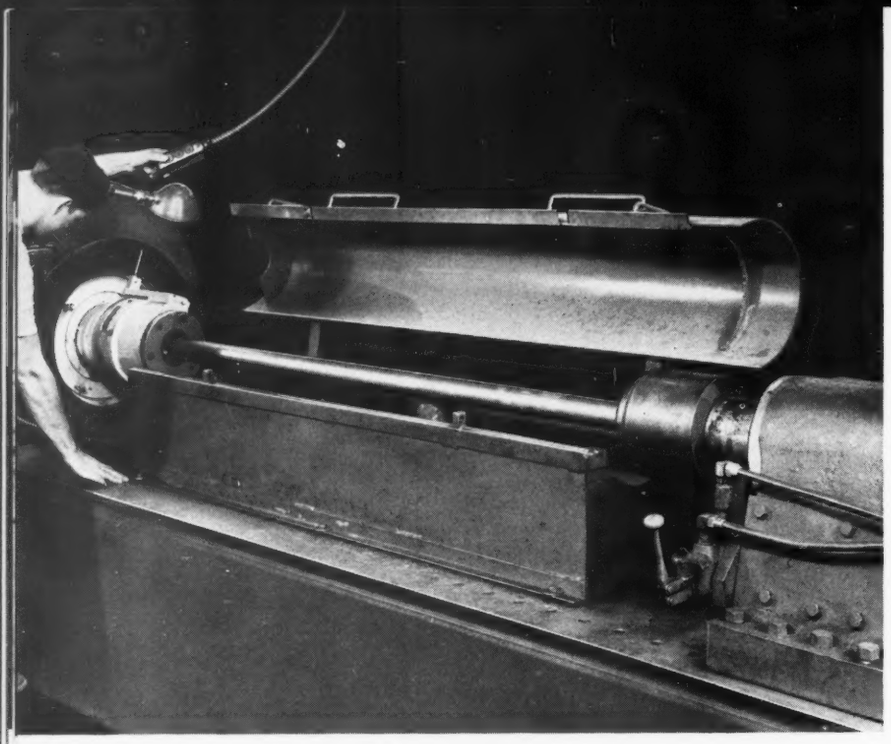


Fig. 12. The torsion-bar springs for tanks are preset by twisting them through a predetermined angle on a special machine equipped with a hydraulically actuated headstock

diameter shoulder is finish-turned at the sixth station. In this case, the tool feed is increased to 0.012 inch per revolution, while the work speed is slowed down to 46 feet per minute.

The work is held stationary at the seventh station while ten bolt-holes in the flange are rough-drilled to a diameter of 1/2 inch. The drills are rotated at 340 R.P.M. and fed at 0.0026 inch per revolution. At the eighth and last station, the ten bolt-holes are finish-drilled to a diameter of 0.9705 inch and chamfered, and six holes, 5/16 inch in diameter, are drilled and chamfered. When the completed part has been indexed back to the first station, it is unloaded and another forging is placed in the fixture.

From ten to eighteen torsion-bar springs, 6 feet long, are used on each tank. These straight, solid bar springs are forged from molybdenum-alloy steel and have involute serrations on both ends. The serrated ends are of larger diameter than the remainder of the bar. One end of each spring is held in a stationary anchor plug on the tank, while the other end is anchored in a swinging road-support lever which carries the road wheels. As the wheels move upward in passing over some obstruction, the torsion bars are twisted. In resisting this twisting, the bars function as springs.

After machining and hardening, it is necessary to twist the torsion bars. This cold presetting operation, which raises the stresses in the bar and thereby increases its elastic limit, is performed on a special Gogan machine, as seen in Fig. 12. The torsion bar is gripped at both

Fig. 13. Forged-steel piston-rods for the 90-millimeter gun recoil cylinders are superfinished to provide a surface roughness of 16 micro-inches r.m.s.

Pershing tanks, seen rolling down one of the production lines in the Detroit Arsenal, are dismantled, cleaned, and completely rebuilt into powerful new General Patton tanks

ends by means of serrated adapters, one end being held firmly in the air-operated tailstock of the machine so that it cannot rotate, while the other end is twisted by a hydraulically actuated vertical rack and gear on the headstock. The amount of twist imparted to the bar is indicated by a graduated dial and pointer on the headstock.

One end of the bar is twisted through a specified angle and then released. This twisting is repeated four more times. The permanent set or amount of twist remaining in the bar after this operation must not exceed a specified number of degrees, and must be held within $\pm$ 1 degree of the specified amount.

Each gun recoil cylinder is equipped with two piston-rods. The rods, which are approximately 1 inch in diameter over most of their length—about 3 feet—are forged from an alloy steel. After being machined and hardened, the piston-rods are cylindrically ground to size within $\pm$ 0.0005 inch. It is then necessary to superfinish the piston-rods to obtain a maximum surface roughness of 16 micro-inches r.m.s. This is accomplished on an Ohio superfinishing machine, as seen in Fig. 13. The large-diameter end of the rod is held in a two-jaw chuck on the machine headstock, while the opposite end is held on the tailstock center. A production of four piston-rods per hour is obtained, with the work rotating at 310 R.P.M. and the superfinishing head being fed at 0.014 inch per revolution.

THE ENGINES

A LARGER, more powerful engine—rated at 300 more horsepower than its predecessor—is being built by the Continental Motors Corporation, Muskegon, Mich., to increase the speed and maneuverability of the new 47-ton General Patton tank. This twelve-cylinder, V-type engine is rated at 1040 H.P. when equipped with a supercharger.

This engine is one of six models in a new line of heavy-duty, air-cooled engines designed by Continental for Army Ordnance to develop maximum power with minimum weight and space. Because they do not require radiators, water pumps, and other cooling accessories needed on liquid-cooled engines, they achieve lightness and compactness, which makes them suitable for use in armored personnel carriers, self-propelled guns, heavy artillery and howitzer motor carriages, tanks, and other military vehicles.

An outstanding feature of the new air-cooled engines is simplicity of design combined with a high degree of interchangeability of parts. These characteristics make them particularly suitable for quick mass production, and facilitate their maintenance and repair in the field. Only two basic cylinders—one 4 5/8 and the other 5 3/4 inches in diameter—are used on the six engines. Differences in power are obtained by increasing the number of cylinders and the compression ratio in the basic cylinders.

Fig. 1 shows the final assembly line for the twelve-cylinder, air-cooled tank engine. Some outstanding operations are performed in machining the large aluminum castings and alloy-steel forgings for these engines, as described in this article.

The crankcases for the engines are cast from S A E 322 aluminum alloy containing 1.3 per cent copper, 5.0 per cent silicon, 0.5 per cent magnesium, and the balance aluminum. The twelve cylinder holes in the crankcase are finish-bored and chamfered, three holes at a time, on the Ex-Cell-O three-spindle, angular-head boring machine seen in Fig. 2. A tolerance of 0.005 inch is maintained on the diameters of the cylinder holes (6.125 inches) and on the 60-degree included angle chamfers (6.417 inches).

The crankcase is held in a fixture on the indexing table of the boring machine by means of five clamps. Each of the three spindle quills is provided with two carbide tool bits, one for boring and one for chamfering. The spindles are rotated at 500 R.P.M. and fed at the rate of 2 1/2 inches per minute (0.005 inch per revolution) through a stroke of 1 3/4 inches.

When these operations have been completed on three cylinder holes on one side of the crankcase, and the tools have been retracted, the table of the boring machine is indexed to align the remaining three holes with the spindles. As soon as one bank of six cylinder holes has been finished, the crankcase is tilted through an angle of 90 degrees by means of the large handwheel seen at the right-hand end of the fixture, and the six holes on the opposite side are bored and chamfered. Four passes of the three spindles are thus required. A crankcase is completed in about 17 1/2 minutes.

A rather unusual operation is the finish-broaching of the bearing cap slots and corners, the contact surfaces at the crank center line, and the inner faces of the cross-bolt bosses in the cast-aluminum crankcase. This is performed on the Colonial 15-ton, 90-inch stroke, horizontal surface broaching machine illustrated in Fig. 3. Six flat surfaces on each of the seven transverse webs in the casting, in addition to the radii in the corners of the bearing cap slots, are finish-broached in a single pass. The broached surfaces are indicated by heavy lines on the cross-sectional view of the crankcase in Fig. 4. As shown on the drawing, widths are held to $\pm$ 0.001 inch, and the height to $\pm$ 0.002 inch. Squareness and parallelism are maintained to 0.0005 inch.

Locating pins projecting from the crankcase flange fit into recesses in the platen of the broaching machine to center the work for the operation. A single hand-operated lever, seen on the front of the machine in Fig. 3, actuates a series of four dogs along each side of the crankcase. The dogs grip the casting flanges, holding them firmly against the machine platen. Depth of cut on the various surfaces averages about 0.047 inch. The total length of cut is 51 1/2 inches, and the ram passes through the work at the rate of 62 1/2 inches per minute.

All 168 cylinder stud holes in the flanges on the cast-aluminum crankcase are drilled, counterbored, and tapped on the Snyder special two-way, V-type machine shown in Fig. 5. Twelve of the

THAT POWER OUR TANKS

New More Powerful Engines for the General Patton Tanks are being Manufactured by the Continental Motors Corporation. Outstanding Operations Performed in Machining the Large Aluminum Castings and Alloy-Steel Forgings for These Twelve-Cylinder, Air-Cooled Engines are Described

By CHARLES H. WICK

A United States Tank moves into position somewhere in Korea

U. S. Army Photo

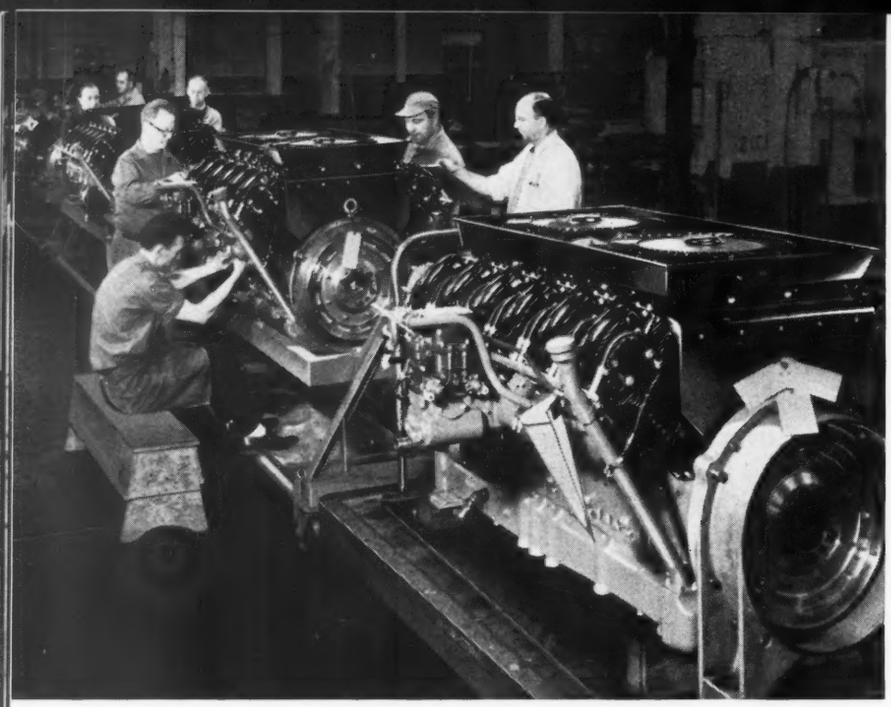


Fig. 1. Final assembly line for twelve-cylinder, air-cooled engines employed to power 47-ton General Patton tanks

holes in each cylinder flange surface are drilled to 0.368 inch in diameter for 7/16-14 thread taps, and counterbored to a diameter of 0.45 inch for a depth of 0.12 inch. Ten of these holes are drilled through the crankcase casting, while two are drilled to a depth of 1.44 inches. Two more holes in each of the twelve cylinder flanges are drilled to a diameter of 0.4855 inch and a depth of 1.44 inches for 9/16-12 taps, and counterbored to a diameter of 0.57 inch for a depth of 0.12 inch.

The machine is equipped with six fourteen-spindle angular heads—three right-hand and three left-hand. One pair of right-hand and left-hand heads is tooled to drill the fourteen holes around one cylinder hole in opposite sides of the crankcase. The next pair of heads is tooled to counterbore the previously drilled holes. Taps on the third pair of heads thread the previously drilled holes. In this way, twenty-eight holes are drilled, counterbored, and tapped at each downward stroke of the six heads. When the heads are raised, the crankcases are indexed longitudinally to align six more cylinder flanges with the tools.

Commercial-ground high-speed steel taps are employed to obtain a Class 3 fit. The flutes of the taps are chromium-plated to resist wear and increase life between sharpenings. The drills and counterboring tools are rotated at 2200 R.P.M. and fed at a rate of 10 1/2 inches per minute (0.0048 inch per revolution), while the taps are rotated at 816 R.P.M. A crankcase is completed in about sixteen minutes.

After assembling the studs, dowels, bearing caps, and cross-bolts to the crankcase, the seven bearing surfaces for the crankshaft are both semi-finish- and finish-bored on a W. F. & John Barnes single-end boring machine, as shown in

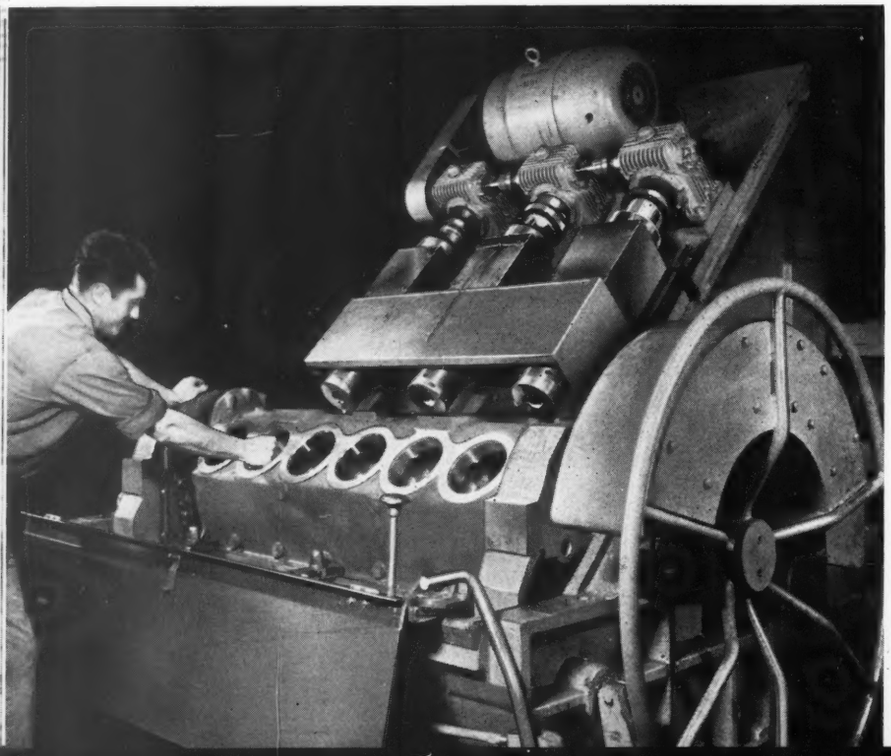


Fig. 2. Cylinder holes in the cast-aluminum crankcases for twelve-cylinder tank engines are bored three at a time

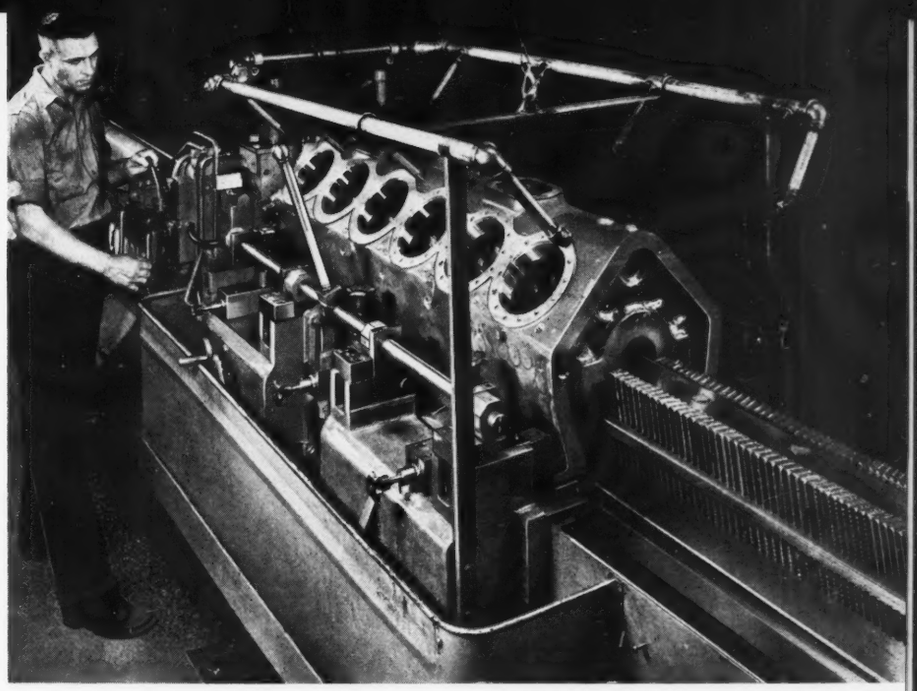


Fig. 3. Fifteen-ton machine used to broach six flat surfaces and the connecting corners in a single pass

Fig. 6. The crank bores are semi-finish-bored to a diameter of 3.800 to 3.801 inches, and finish-bored to a diameter of 3.8140 to 3.8145 inches.

At the end of the semi-finish-boring operations, a finish boring-bar is substituted in the headstock of the machine. Both the semi-finish and finish boring-bars are equipped with seven tungsten-carbide tipped tool bits. The bars are rotated at 424 R.P.M. and fed at 0.0027 inch per revolution through a stroke of 3.840 inches. Stock removed from the bore diameters in semi-finishing averages 0.020 inch, while in finish-boring, about 0.013 inch is removed.

Following the boring operations just described, all holes in both the flywheel and accessory ends of the cast-aluminum crankcase are drilled, counterbored, countersunk, reamed, and tapped on a special Snyder two-way, four-station machine, Fig. 7. The machine is equipped with ninety-seven drilling and thirty-six tapping spindles on four heads. An indexing table carries the crankcase from station to station.

In the accessory end of the crankcase, eleven holes 0.3695 inch in diameter are drilled, counterbored, and tapped; four holes 0.4855 inch in diameter are drilled and reamed; six holes 0.500 inch in diameter are drilled; and two cast impressions 0.500 inch in diameter are counterbored.

In the flywheel end of the crankcase, twenty-six holes varying in diameter from 0.2585 to 0.3875 inch are drilled, counterbored, and tapped; five holes 0.2355 and 0.4855 inch in diameter are drilled, countersunk, and reamed; and the oil-hole is tapped with a pipe thread. The different sized drills and counterboring tools are rotated at various speeds to give a surface speed of about 250 surface feet per minute. Reamers are rotated at about 175 feet per minute, and taps at 100 feet per minute. A production of three crankcases per hour is obtained.

Valve rockers for the twelve-cylinder tank engine are drilled, reamed, chamfered, and milled on the special Kingsbury nine-station rotary indexing machine shown in Fig. 8. The rockers are forged from S A E 8640 steel, heat-treated to a hardness of 33 Rockwell C, and shot-peened with S A E No. 230 steel shot prior to machining.

The valve rockers are located from the previously ground shaft hole and manually clamped in special work-holding fixtures on the rotary indexing table at the first station. At the second

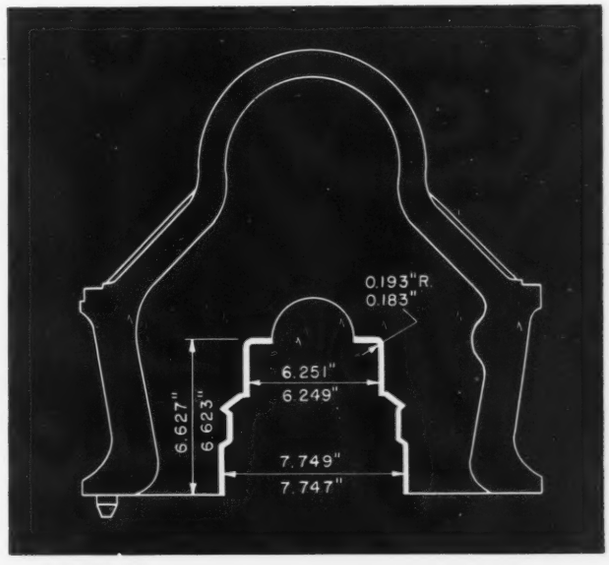


Fig. 4. Cross-sectional view of the crankcase casting. Heavy lines indicate the surfaces broached in the set-up seen in Fig. 3

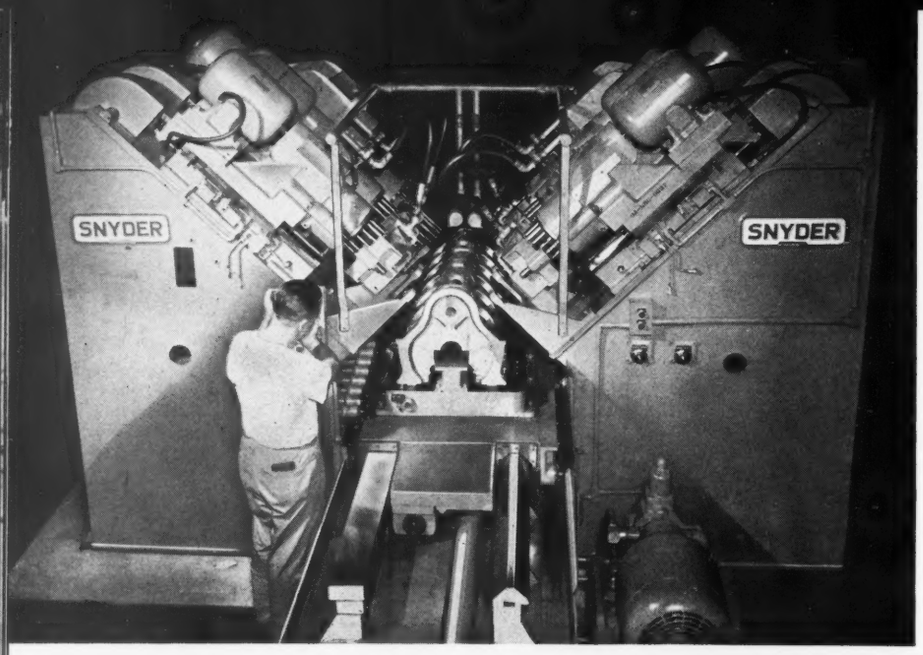


Fig. 5. A total of 168 cylinder stud holes are drilled, counterbored, and tapped in crankcase on a two-way, V-type machine

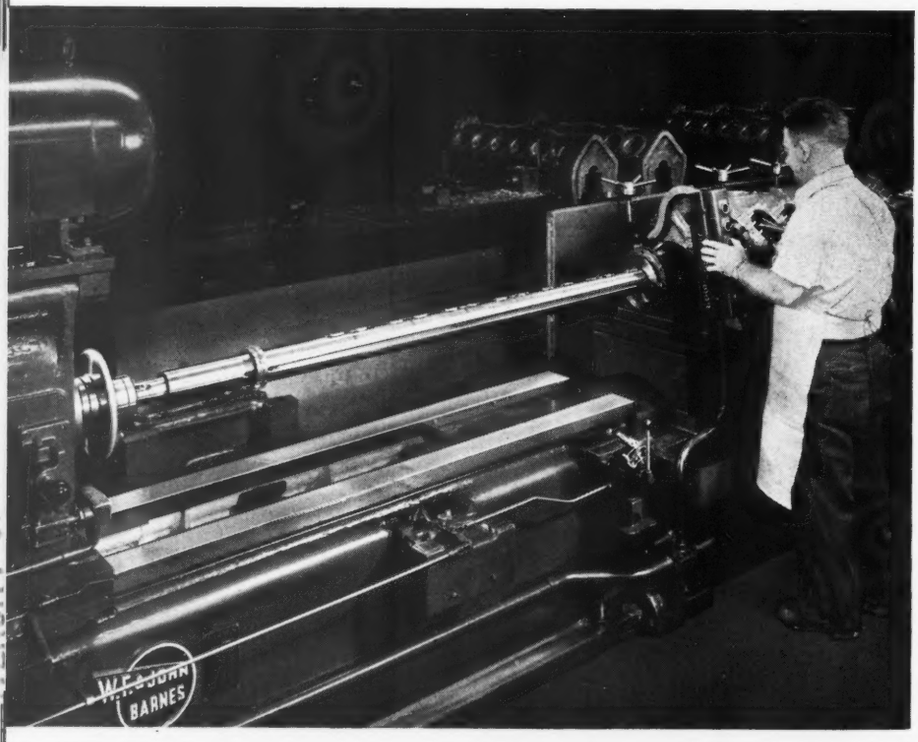


Fig. 6. Seven crank bores in the crankcase are semi-finish-bored and then finish-bored within 0.0005 inch total tolerance on this single-end machine

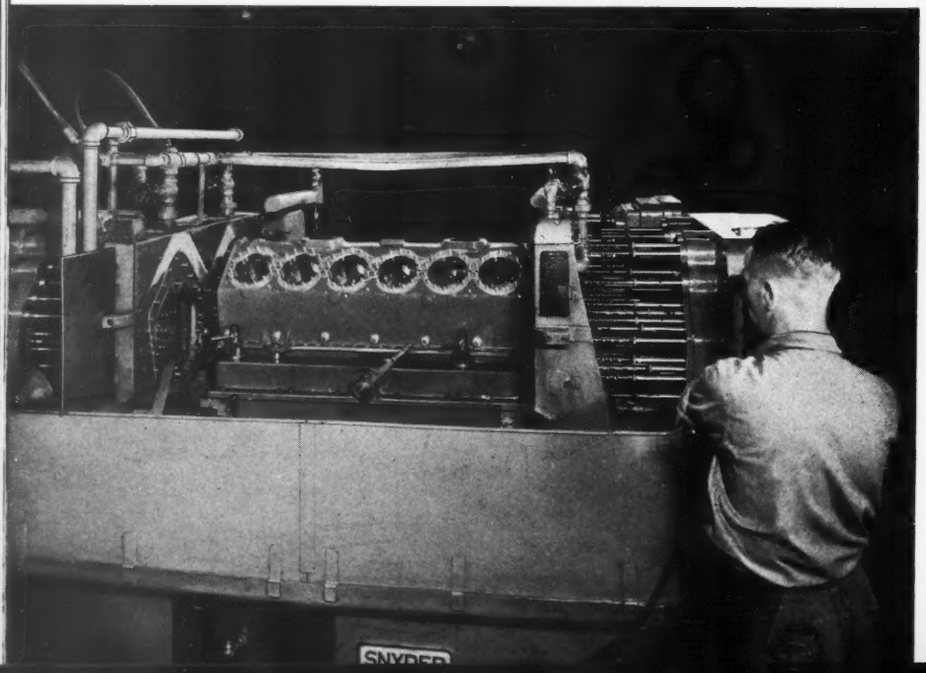


Fig. 7. Two-way, four-station machine provided with ninety-seven drilling and thirty-six tapping spindles for machining both ends of the crankcase

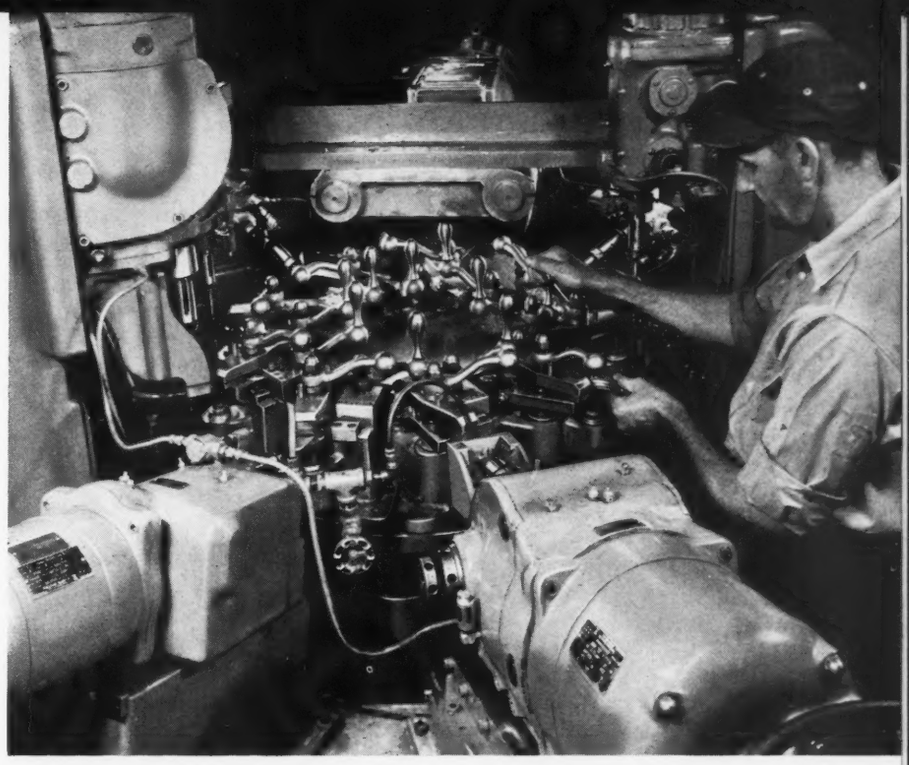


Fig. 8. Valve rockers for the tank engine are drilled, reamed, chamfered, and milled at the rate of twenty-five per hour

station, an oil-hole, 5/32 inch in diameter and 5/8 inch deep, is drilled in the work. The high-speed steel drill used rotates at 760 R.P.M. and is fed at the rate of 0.0025 inch per revolution. Another oil-hole—0.073 inch in diameter by 13/32 inch long—is drilled at the third station, and a third hole, 0.302 by 3/4 inch, is drilled at the fourth station. These drills are rotated at about 30 surface feet per minute, and fed at 0.0012 and 0.0033 inch per revolution, respectively. The 0.302-inch diameter hole is countersunk to a diameter of 13/32 inch at the fifth station.

When the valve rocker has been indexed to the sixth station, a No. 51 (0.067-inch diameter) drill is fed at the rate of 0.0011 inch per revolution to a depth of 21/64 inch. A slot, 0.302 inch wide by 1 3/8 inches deep and 1 1/8 inches long is milled in the work at the seventh station. The milling cutter, 5 inches in diameter, is rotated at 30 R.P.M. and fed 0.0417 inch per revolution. At the eighth station, a hole 1/16 inch in diameter is drilled to a depth of 21/64 inch. The 0.302-inch hole drilled at the fourth station is reamed to a diameter of 0.3125 inch at the ninth and final station. Rockers are completed at the rate of twenty-five per hour in this operation.

Forged S A E 1020 steel flywheels for the tank engines are rough- and finish-machined on Gisholt Simplimatic, platen type automatic lathes, Fig. 9. In the operation illustrated, the clutch side of the flywheel is finish-faced, bored, and turned at the rate of thirteen per hour. The large flat table or platen of the lathe is equipped with

Fig. 9. Clutch side of forged steel flywheels is finish-faced, bored, and turned by means of eleven tools on an automatic lathe at rate of thirteen an hour

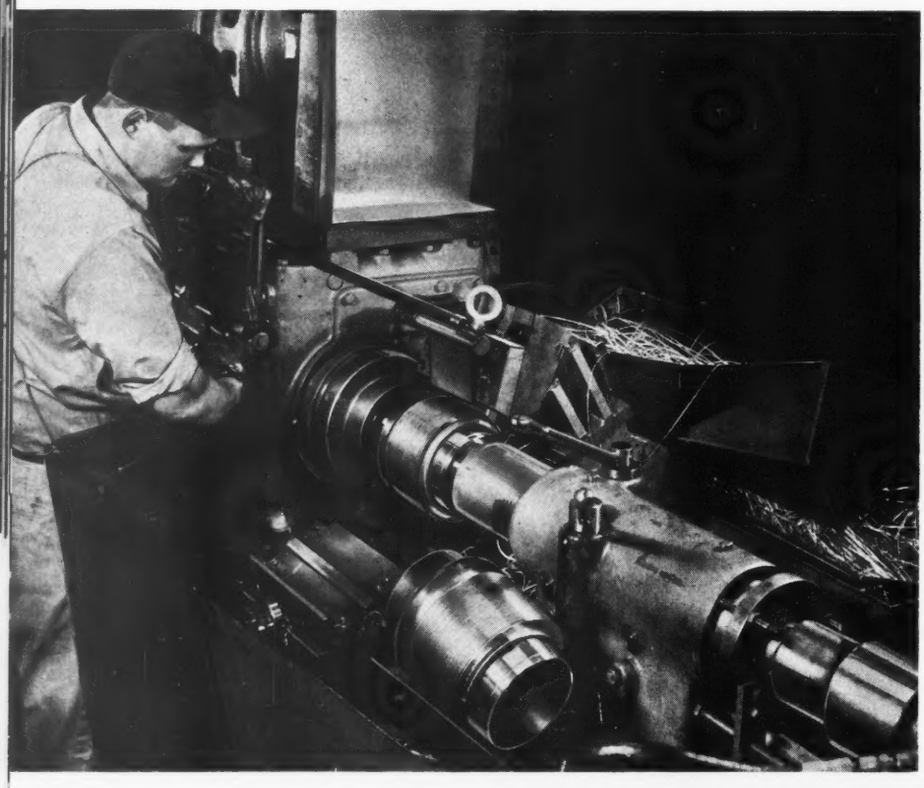


Fig. 10. Aluminum-alloy muffs that have been bonded to steel cylinder liners are grooved to form thirty-seven cooling fins

Fig. 11. Four-way horizontal drilling machine for drilling and counterboring ten holes in the cast-aluminum cylinder heads

two slides, each having its own individual drive, feed rate, and direction of feed. The complete cycle, including advance of the platen, feeding of the tools, and retraction of the platen and toolslides, is automatic, making it possible for one operator to attend two machines.

Eleven tungsten-carbide tipped tool bits are employed in this operation. The forging is ro-

Fig. 12. Splines are machined in both the bore and around the periphery on one end of the forged-steel crankshafts for the tank engine

tated at 83 R.P.M., while the facing tools are fed at the rate of 0.0145 inch per revolution and the boring tools at 0.0096 inch per revolution.

Alumium-alloy muffs are molecularly bonded to thin-walled steel cylinder liners by means of the "Al-Fin" process. This patented process was developed by the Fairchild Engine & Airplane Corporation. The bi-metallic cylinder barrels produced combine the high heat conductivity and light weight of aluminum with the strength and resistance to abrasive wear of the alloy steel. The process, described on page 173 of August, 1950, MACHINERY, consists of casting molten aluminum alloy around a specially prepared surface on the steel liner.

Grooves are then turned in the aluminum-alloy muff of the bi-metallic cylinder barrel to form cooling fins. This operation is performed on the Fay automatic lathe seen in Fig. 10. Thirty-seven tungsten-carbide tipped finning tools (separated by thirty-six spacers) and two carbide-tipped facing tools are employed. The cylinder barrel is rotated at 300 R.P.M., and the cam-fed tools advance 0.005 inch per revolution to fin each barrel completely in about three minutes.

The space between adjacent fins is 0.0735 inch wide by 1 inch deep. Since thirty-seven fins are machined simultaneously, chip disposal presented quite a problem. This has been solved by fitting a special chute to the rear of the automatic lathe to guide the continuous chips to a large tote pan. With this arrangement, one man can operate two machines.

Cast aluminum alloy (Aeronautical Materials Specification 4220) cylinder heads, which are screwed to the cylinder barrels at assembly, are drilled and counterbored on the Buhr four-way, horizontal drilling machine seen in Fig. 11. Ten holes are drilled and counterbored in a 1 1/2 minute cycle, resulting in a production of forty heads per hour. The cylinder heads are clamped in the fixture pneumatically.

At the first station, three holes in the intake pad of the cylinder head are drilled to a diameter of 0.255 inch and counterbored to 0.330 inch. Another hole in the intake pad is drilled to a diameter of 0.685 inch and counterbored to 0.875 inch at the same station. All the tools are rotated at about 125 surface feet per minute, and the head on which the tools are mounted is fed at the rate of 7.5 inches per minute.

Two holes in each of the two side pads on the cylinder head are drilled to a diameter of 0.560 inch and counterbored to 0.734 inch at the second and fourth stations. The heads at these two stations travel at the rate of 6.25 inches per minute, giving a feed per revolution of 0.0074 inch for the drills and 0.0096 inch for the counter-

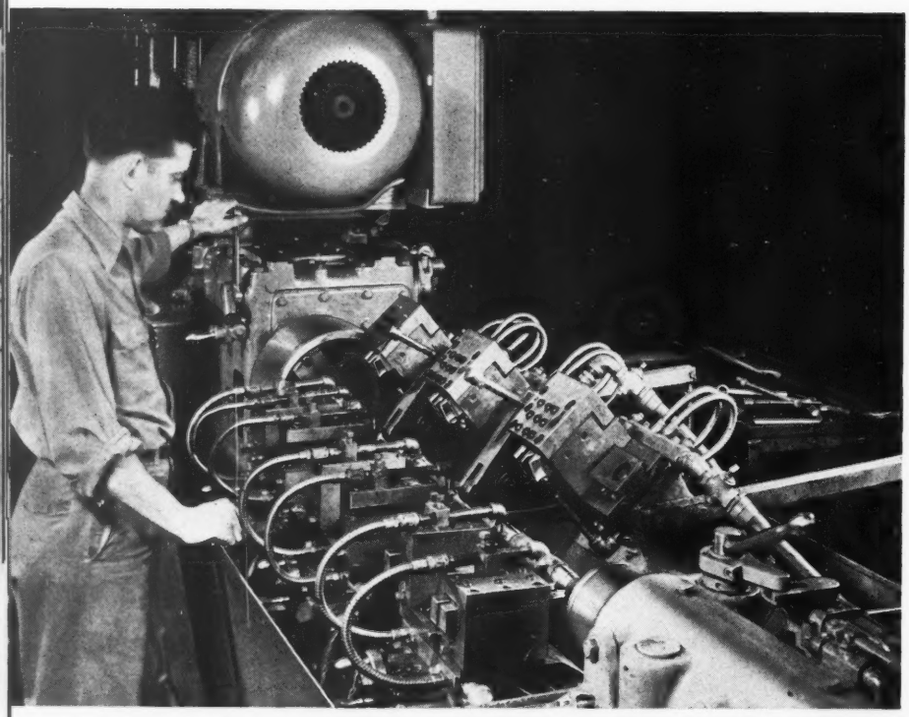


Fig. 13. Camshafts are turned and faced on an automatic lathe provided with eighteen triangular-shaped carbide tool bits

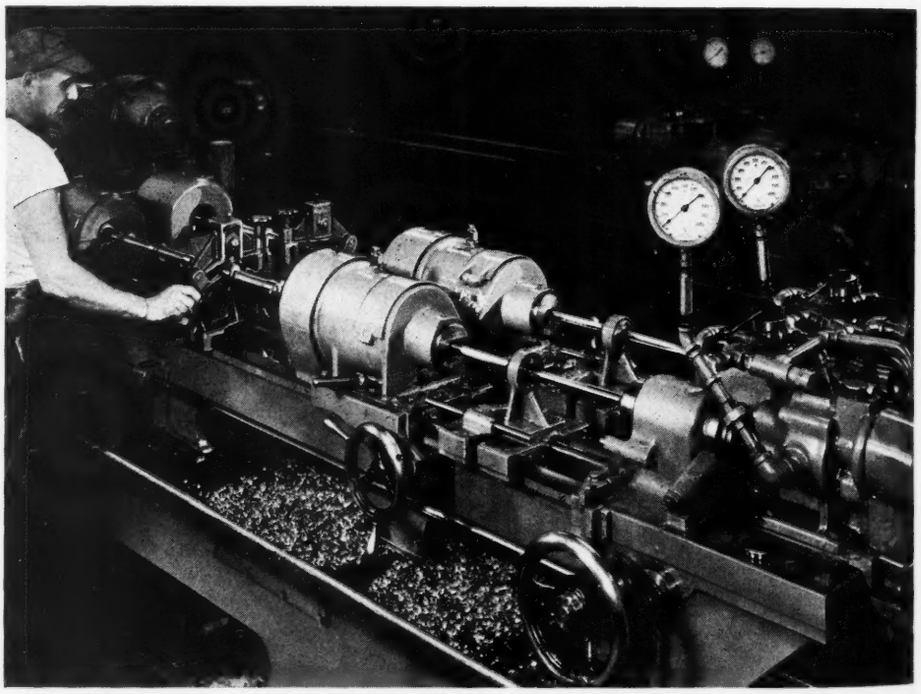


Fig. 14. Two-spindle, deep-hole drilling machine for machining a 1.030-inch diameter oil-hole through the camshaft

boring tools. At the third station, four holes in the exhaust pad are drilled to 0.310 inch in diameter and counterbored to 0.390 inch. The head at this station travels at the rate of 10 inches per minute.

Internal splines are machined in one end of the forged-steel crankshaft for the tank engine on a Fellows gear shaper, as seen in Fig. 12. The crankshaft is loaded into a special fixture, and is held by means of a split collar, which fits over the front main bearing of the crankshaft, and a steadyrest. The table on which the work-holding fixture is mounted is advanced toward the cutter and the feed is engaged. The high-speed steel cutter operates at 230 strokes per minute, completing a crankshaft in twenty-four minutes.

Bearing surfaces and relief areas on the forged S A E 4620 steel camshafts are turned and faced

on Fay automatic lathes, as seen in Fig. 13. The camshafts are held at one end by a two-jaw, compensating type air chuck, and at the other end by a tailstock center. Two steadyrests are also employed to support the long, slender shaft.

Eighteen triangular-shaped, tungsten-carbide tool bits are used on one machine in turning the bearing surfaces and body of the camshaft. The work is rotated at 600 R.P.M., and the cam-fed tools travel at the rate of 0.008 inch per revolution. As was the case in finning the cylinder barrels, one man operates two of the automatic lathes. In this instance, a production of fourteen camshafts per hour is obtained from each machine.

After shot-peening, grinding the bearing surfaces, and straightening if necessary, an oil-hole 0.969 inch in diameter is drilled through the entire 52-inch length of the camshaft. This hole is subsequently reamed to a diameter of 1.030 inches. These operations are performed on Pratt & Whitney two-spindle deep-hole drilling machines, Fig. 14. One end of the camshaft is held in a three-jaw universal chuck, and additional support is provided by three bushings and a steadyrest.

The work is transferred from one spindle to the other on each machine, half of the hole length being drilled from one end of the camshaft while the other half is drilled from the opposite end. The camshafts are rotated at 370 R.P.M. (97 surface feet per minute), and the drills are fed into the work at the rate of 0.0014 inch per revolution or 1/2 inch per minute.

Chips coming from the drilled holes are carefully observed, since they are a good indication of whether the hole is being drilled straight. A center-line overlap of only 0.005 inch is maintained where the two holes meet near the center of the camshaft. The entire length of the hole is reamed from one end of the shaft in another machine.

The large housing that encloses the accessories necessary for the engine is cast from SAE 322 aluminum alloy. Six holes are rough-bored, faced, and chamfered in the accessory cases from the front, and five holes from the rear, on the special Snyder two-way, eleven-spindle machine seen in Fig. 15. The accessory case is located vertically on the centrally located fixture, and secured by means of seven clamps. Both right- and left-hand heads on the machine are rapidly traversed up to the work, after which the feed is automatically changed to 3/8 inch per minute for cutting. The cutting speeds of the tools average about 300 surface feet per minute.

Two- and three-step tungsten-carbide tipped end-mills with from five to twenty blades are employed in this operation. Mounting holes for the tank engine starter are bored and chamfered

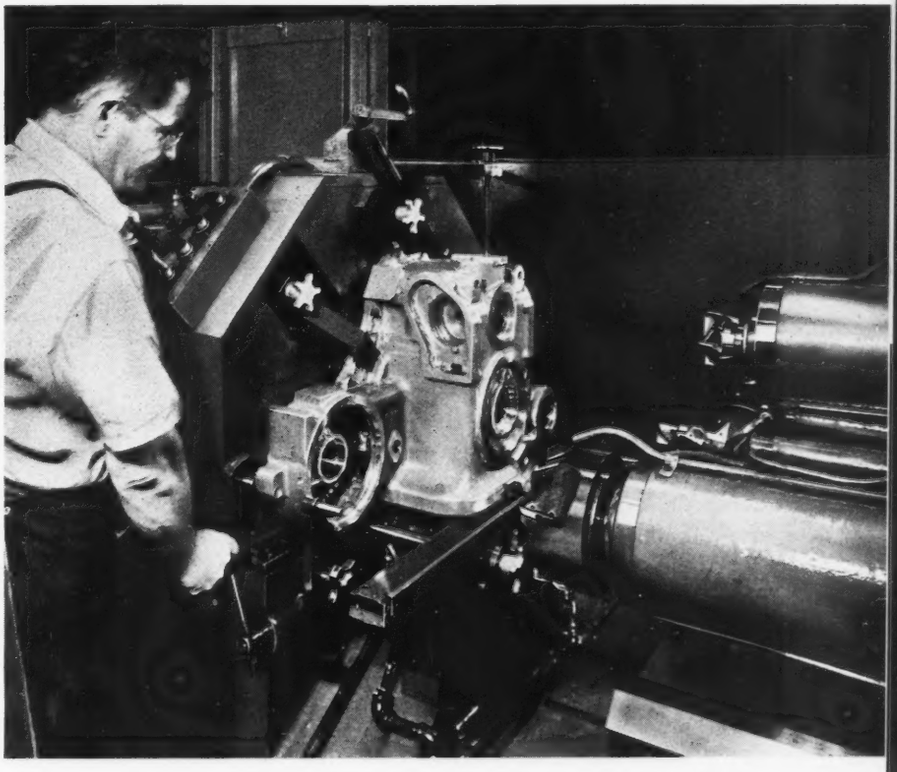


Fig. 15. Holes in the cast-aluminum alloy accessory cases for the tank engine are rough-bored, faced, and chamfered in this operation

Fig. 16. Five-way boring machine for rough-boring and chamfering five holes in the sides and bottom of aluminum accessory cases

Fig. 17. Mounting, clearance, and drive-shaft holes in the accessory case are finish-bored and faced on this two way machine

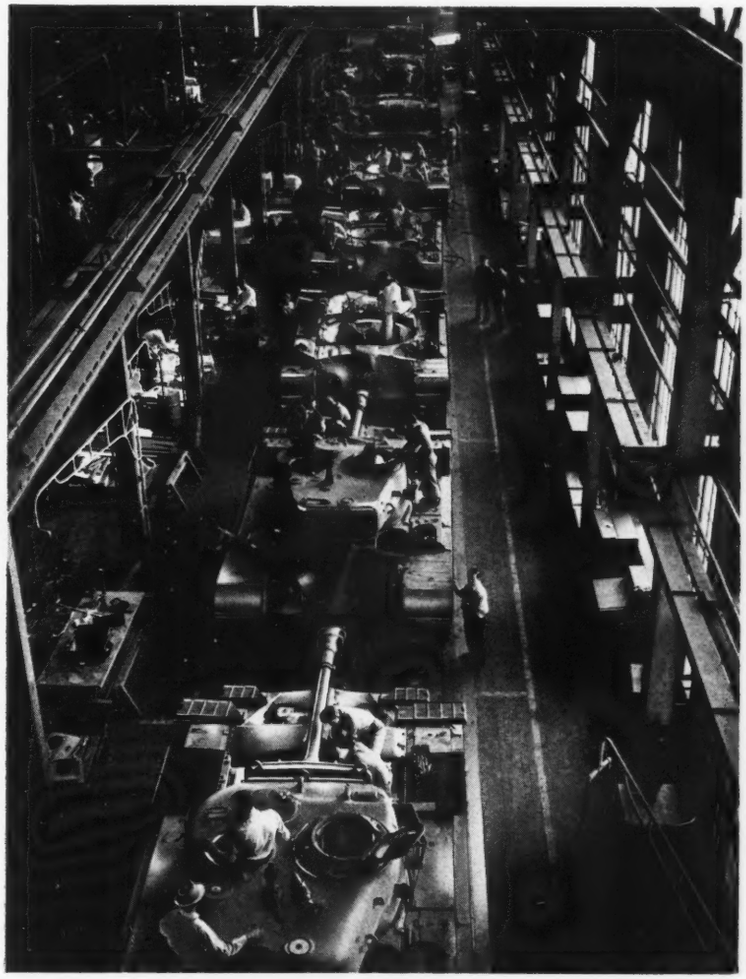
to diameters of 4.125, 3.6215, and 2.875 inches. The fuel-pump drive-shaft hole is bored to 7.875 inches diameter and faced. A clearance hole for the left-hand idler shaft is drilled from both front and rear of the housing to a diameter of 0.9972 inch. The center drive-shaft hole is bored, hollow-milled, and faced to diameters varying from 2.625 to 7.22 inches. A clearance hole for the right-hand idler shaft is drilled from the front of the housing to 1.250 inches diameter. The oil-filter mounting hole and the generator drive-shaft holes are bored and faced to diameters varying from 1.500 to 4.125 inches.

Five holes in the sides and bottom of the cast-aluminum accessory case are rough-bored and chamfered on the W. F. & John Barnes special five-way boring machine seen in Fig. 16. The case is lowered into position on locators in the fixture and secured by three clamps. Tungsten-carbide tipped boring and chamfering tools are held in the boring-bar on the No. 1 head. The boring-bar is rotated at 460 R.P.M. (420 surface

feet per minute), and the head is fed at the rate of 0.0036 inch per revolution to bore the oil-pump mounting hole to a diameter of 3.479 inches.

Carbide-tipped spade bits are held in the boring-bars on the other four heads of the machine for rough-boring two cam and two magnet drive-shaft holes, all 1.9375 inches in diameter. These four boring-bars are rotated at 830 R.P.M., and the heads are fed at 0.002 inch per revolution. Actual machining time is about two minutes per accessory case, and handling time (loading and unloading) is approximately 5 minutes, resulting in a production of eight cases per hour.

Following these operations, bushings, pins, and studs are assembled to the partially machined accessory case casting. Clearance, mounting, and drive-shaft holes for the tank engine eccessories—which were previously rough-bored and faced on the machine seen in Fig. 15—are finish-bored and faced on an Ex-Cell-O two-way, ten-spindle, precision boring machine, Fig. 17. The center drive-shaft hole is finish-bored to 2.3755 inches in diameter within a tolerance of ± 0.0002 inch. In this precision operation, most of the carbide-tipped tools are rotated at 1500 R.P.M. and fed at 0.003 inch per revolution.



COLD-EXTRUDED SHELLS

Improved Quality, High-Strength Artillery Shells Can Now be Produced from Ordinary Low-Carbon Steel by the Cold-Extrusion Process. Substantial Savings of Steel are Possible, and Highly Uniform, More Accurate Shells Result

By BEN KAUL
Chief Tool and Die Engineer, Warren, Ohio, Plant
Mullins Mfg. Corporation

American artillery gun crew in action with a 105-millimeter howitzer somewhere in Korea

U. S. Army photo

FOR THE FIELD ARTILLERY

COLD extrusion, a process that consists essentially of forcing unheated metal to flow through a shape-forming die, has been applied successfully for many years to the production of various non-ferrous products. Ferrous metals, however, have not been cold-extruded into finished parts on a production basis because of the heavy pressures necessary; unavailability of die materials that would withstand the high stresses imposed; lack of properly designed dies; and the need for a suitable die lubricant.

In 1947, the Mullins Mfg. Corporation began experimenting with the cold-extrusion of steel, and has recently perfected the process for the production of steel artillery shells. The successful cold-extrusion of steel is a development of major importance to the metal-working industry, as it makes possible the production of more parts from less material at lower cost.

External and sectional views of a 105-millimeter shell made by the cold-extrusion process are shown in Fig. 1. Artillery shells extruded from slugs of ordinary low-carbon steel bar stock at room temperatures are more uniform and accurate than those produced by forging in the conventional manner. Whereas forged steel shells require a weight tolerance of ± 9.6 ounces, the weight of cold-extruded shells is maintained within ± 2 ounces. The great variation in weight of forged shells makes it necessary to grade the shells, or set up "weight zones." After being filled with explosive, each shell is weighed and marked with its weight zone. The artilleryman in the field must adjust the elevation of the gun to compensate for the zone weight marking on the nose of the shell. The uniform weight of extruded shells eliminates the grading, and thus saves time in production and in the field.

When produced by cold extrusion, a 105-millimeter shell requires only 27 pounds of steel. With the old hot forging method, an average of 42 pounds of steel is necessary for the same size shell because of overfill during forging, high losses in machining, and scaling during heat-treatment. It has been estimated that the cold-extrusion process will result in a 40 per cent reduction in steel requirements for shells. For example, if all the 105-millimeter shells made during World War II—approximately 100,000,000 —had been cold-extruded, about 960,000 tons of steel would have been saved.

The wall thickness tolerance of 0.044 inch previously allowed on forged shells has been reduced to ± 0.003 inch with the cold-extrusion process. Also, since the extruded shell has the same smoothness as the die in which it is produced, a surface finish of 100 micro-inches r.m.s., or less, is consistently obtained. The surface finish of forged and machined shells varies from 250 to 500 micro-inches r.m.s. The smoother surface of extruded shells and their consistent weight improve their range and accuracy, giving the shells more uniform trajectory characteristics.

Forged 105-millimeter M1 shells are made from a silicon-killed steel containing 0.47 to 0.55 per cent carbon, 0.77 to 1.00 per cent manganese, 0.15 to 0.35 per cent silicon, a maximum of 0.055 per cent phosphorus, and a maximum of 0.06 per cent sulphur. In the cold-extrusion process, A.I.S.I. C-1012-killed, hot-rolled steel bar stock containing only about 0.45 per cent manganese is employed. The higher manganese content of the forging steel is necessary for improved machinability (since more machining is required on forged shells) and hardenability. The estimated savings in manganese alone on 100,000,000 cold-extruded 105-millimeter shells are 250 tons of contained manganese over the same number of shells made by hot forging.

The use of a steel containing less carbon and manganese is possible because uniformly high mechanical properties are obtained by cold-working without heat-treatment. Typical of the mechanical properties obtained after a stress-relieving heat-treatment of the cold-extruded shell are: Yield strength (0.1 per cent set), 74,000 pounds per square inch; ultimate tensile strength, 87,000 pounds per square inch; elongation in 1 inch, 15 per cent; reduction of area, 59 per cent; and hardness, 91 Rockwell B. The chemical composition of forging steels must be maintained within close limits to obtain uniformity of mechanical properties obtained in heat-treatment.

Less specially made or treated steel is necessary to make perfectly sound, high quality shells by cold extrusion. The yield from an ingot of killed bar quality steel used for shell extrusion

COLD-EXTRUDED SHELLS FOR THE FIELD ARTILLERY

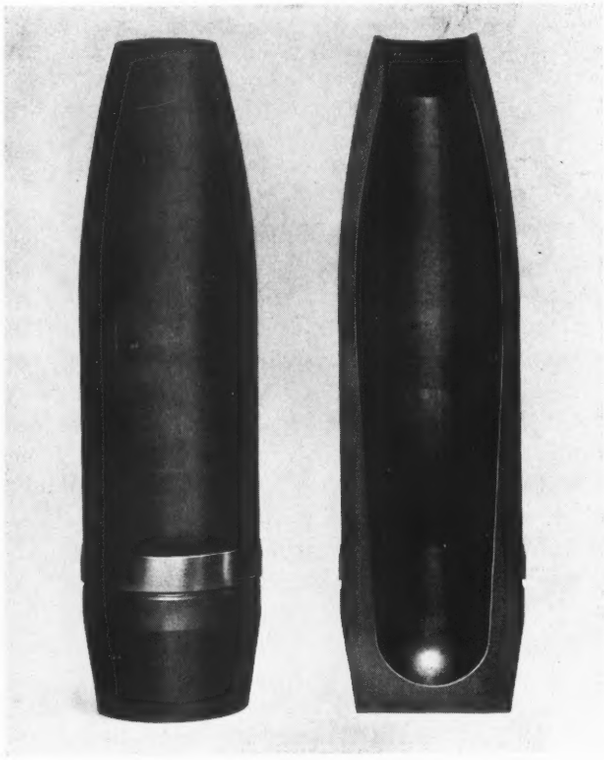


Fig. 1. (Left) Exterior view and (right) sectional view of 105-millimeter howitzer shell extruded from an unheated slug of low-carbon steel bar stock

varies from 75 to 80 per cent, while the yield from an ingot of special shell-quality forging steel, where defects must be held to a minimum, averages only about 70 per cent. Also, more inspection is required at the steel mill in producing shell-quality steel.

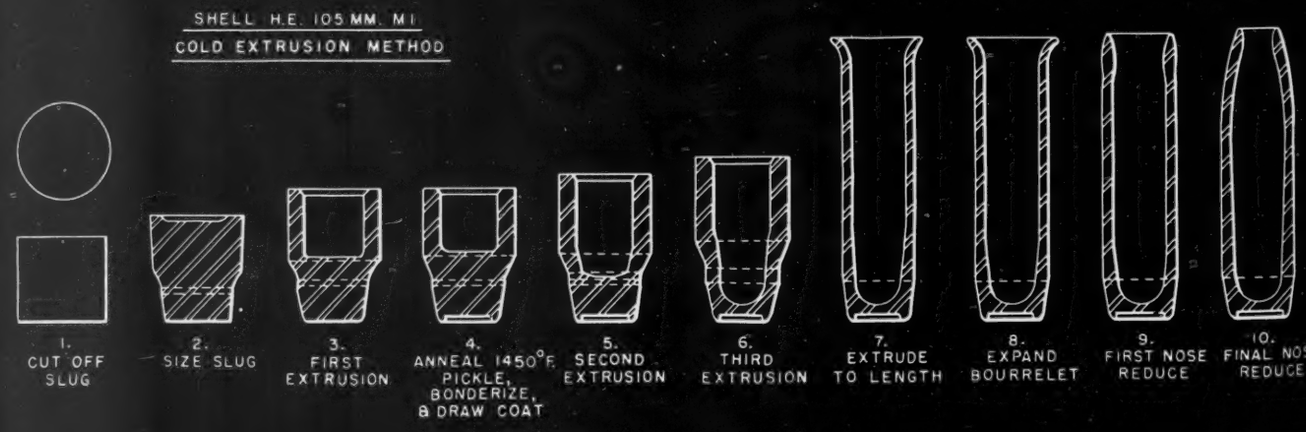
Defects such as inclusions, porosity, and stringers are broken up by the kneading action or deformation of the metal during cold extrusion. Flow lines of the cold-extruded steel are clearly visible in the etched macrograph of the sectioned 105-millimeter shell seen in Fig. 3. An idea of the way in which defects are eliminated by this process will be obtained from the fact that when holes 1/8 inch in diameter were drilled through the slug, the holes could not be found after the slug had been extruded.

Relatively little floor space was required for the development of the cold-extrusion method of producing shells, as can be seen by the installation shown in Fig. 4. Very little machining is necessary with this method, resulting in savings in finishing equipment cost. Also, further savings are made in the cost of gas or oil, since intermediate heat-treatments are reduced to a minimum.

In the cold-extrusion process perfected by the Mullins Mfg. Corporation for the manufacture of 105-millimeter howitzer shells, the 5-inch diameter steel bars are sawed into slugs approximately 4 11/16 inches long. A circular sawing machine or hacksaw is employed for this operation, and the weight of the slugs is maintained between 26 pounds 6 ounces and 26 pounds 8 ounces. About 27 pounds of steel is required for each slug, since 8 ounces of metal is lost in sawing.

In the development work, the 105-millimeter shells were cold-extruded on the 3000-ton, 60-inch stroke hydraulic press seen in Figs. 4 and 5. This press is being used experimentally in determining the optimum pressures and ram speeds for cold-extruding other size shells. It has been found that the cold-extrusion process can be performed on mechanical presses, as well as on standard hydraulic presses.

Fig. 2. Successive steps employed in producing howitzer shells



COLD-EXTRUDED SHELLS FOR THE FIELD ARTILLERY

The huge 3000-ton press, which measures 56 feet in height, is operated through push-button controls by a 900-H.P. motor-driven pumping unit mounted on the top. A long stroke is advantageous to facilitate easy unloading and handling. However, on shorter stroke presses, the punch can be gibbed to move it out of the way when the extrusion is being removed from the die. Fig. 2 shows the successive steps in the production of the cold-extruded shells. In the first forming operation, shown as the second step in the illustration, the slug is sized and the "boat-tail" (the lower end of the shell) is compressed. The metal is squeezed outward from the base of the slug, and, since it is not trapped, it passes upward around the punch. In this so-called "backward" extrusion, the metal is forced to flow in a direction opposite to that in which the punch travels. No friction occurs between the metal being extruded and the punch except on the bottom face and at the rounded edge at the lower end of the punch.

The maximum load that can be applied during cold extrusion (or the maximum amount of extrusion possible in one operation) is limited by the degree to which the part is cold work-hardened and the maximum stress that the extruding punch can withstand. It has been found that when any surface of the extrusion reaches a hardness exceeding 102 Rockwell B, the part must be normalized by a stress relieving heat-treatment before further extrusion or cold-working is possible.

Fig. 3. Etched macrograph of a sectioned 105-millimeter shell, showing the flow lines set up by deformation of the metal in cold extrusion

The first extrusion increases the hardness and strength of the partially formed shell more than the subsequent ones—some surfaces of the work attaining a hardness of 98 Rockwell B. It is necessary, therefore, to soften the part and restore its ductility before continuing with the extrusion process. This is accomplished by normalizing at 1450 degrees F., which reduces the hardness to 64 or 65 Rockwell B. Normalizing temperatures should be kept as low as possible, and the parts should be held at heat sufficiently long to restore the original grain structure without grain growth.

In Steps 5 and 6, Fig. 2, the softened part is further elongated by the second and third extrusion dies. The surfaces of the part must remain soft enough to permit further extrusion without again normalizing. The desired hardness pattern on the partially formed shell was obtained only after many trials and modifications of the die and of the extruding pressure.

from low-carbon steel slugs by the cold-extrusion process

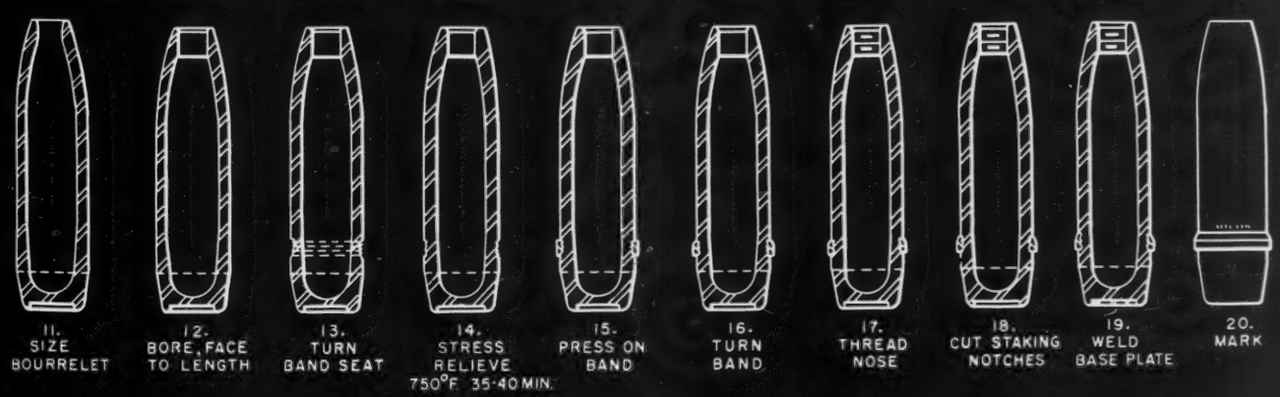


Fig. 4. The 3000-ton hydraulic press used for experimental development in cold extrusion

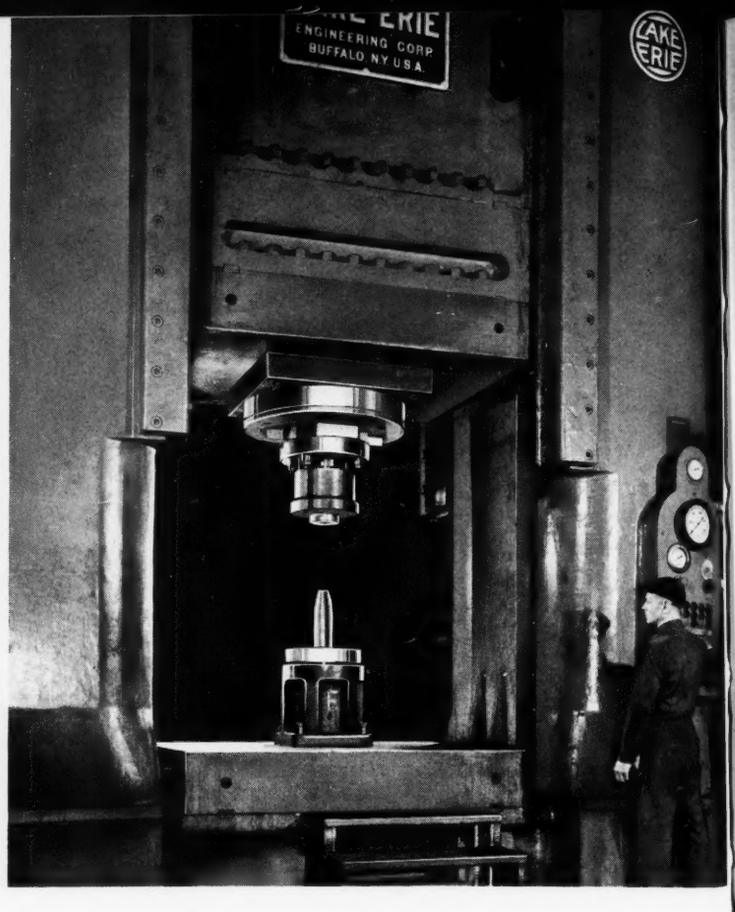


Fig. 5. Close-up view of press illustrated in Fig. 4, showing final nose reduction die

In Step 7, the metal is forced to flow in the direction in which the punch travels, and the shell is extruded to its final length. It should be mentioned that even though the shape of the shell is changed more drastically in each successive extrusion, less pressure is required because a smaller amount of metal is being displaced.

A surplus of metal is left in two areas within the cavity of the extruded shell so that both the forward and rear bourrelets are formed on the periphery of the shell when these areas are expanded in Step 8. At this point in the process, the extruded metal in the area of the sharp flaring edge formed around the upper end of the shell has attained a hardness of about 92 Rockwell B. A 105-millimeter shell is shown in Fig. 6 being removed from the final nose reduction die following Step 10.

Both forward and rear bourrelets, which are 7 inches apart, are sized to a diameter of between 4.124 and 4.127 inches by means of a push-through die in Step 11. The relatively small amount of machining required on cold-extruded shells includes boring and facing the shell to the desired length (Step 12), and turning the band seat (Step 13). Excess stresses set up during

Fig. 6. Removing a 105-millimeter cold-extruded shell from the final nose reducing die of the 3000-ton hydraulic press

Fig. 7. (Left) Slug from which a 105-millimeter shell is produced. (Right) View of completed shell at the end of the manufacturing operations

cold-working are then relieved by heating the shells to 750 degrees F. and maintaining them at this temperature for thirty-five or forty minutes. This stress relieving treatment increases the yield strength and percentage of elongation of the extruded metal with little effect on its ultimate tensile strength.

After stress relieving, the copper rifling band is pressed on the cold-extruded shell by means of a conventional tire-setting machine, and the band is then turned to the required size. Following this operation, the nose of the shell is threaded internally, and staking notches are cut around the upper edge. After welding the baseplate to the bottom and marking, the shell is completed. A finished shell is shown beside a slug in Fig. 7. It has been estimated that in a production set-up, shells could be produced from any of the nine dies required for the complete operation at the rate of 250 per hour.

MOTORS THAT PROPEL THE

AMONG the most effective weapons used by the armies of the United Nations in the war against North Korea are the 3.5-inch rockets. These rockets knocked out the Red tanks which had been operating with devastating success against the South Koreans and the United States troops in the early weeks of the conflict.

Rockets consist essentially of a "war head," which contains an explosive sufficiently powerful to cause penetration of heavy armor plate upon impact, and a so-called "motor," which consists of a body loaded with a propellant that provides the terrific energy necessary for driving the rocket to its objective. A fuse between the war head and the motor is set off upon impact to detonate the war head. Fins at the back end of the motor body direct the rocket in the path in which it is started by the rocket launcher. A complete 3.5-inch rocket is illustrated in Fig. 1, while Fig. 2 is a disassembled view, showing the motor body at the right, the motor closure plug in the middle, and the fin assembly at the left.

Manufacture of the 3.5-inch rocket motor bodies presents certain difficulties, due to the fact that they must be light in weight and at the same time strong enough to guarantee against the possibility of rupture while in the rocket launcher. At the Heckethorn Mfg. & Supply Co., Littleton, Colo., where these parts are made, two hydrostatic tests are given each motor body forty-eight hours apart to insure against the delivery of defective motors to the Army. Internal pressures of 25,000 pounds per square inch are applied in these hydrostatic tests. Similar tests are made on the closure plugs which are used to seal the fuse end of the body when the rocket is discharged.

In addition to careful forging and machining methods, successful manufacture of the rocket motors is due to the application of heat-treating methods that are selected specifically for each heat of steel. The quenching temperature depends upon the exact analysis of the steel from each heat, and is always 45 degrees above the martensite formation point. All steel received at this plant is inspected for surface defects, and samples from each heat are checked for chemical analysis. Two specimens are then run through the selected heat-treating process, after which they are subjected to physical property tests. The steel used for the bodies must have the following physical properties: Yield strength, 145,000 pounds per square inch minimum; and elongation, 10 per cent minimum.

The motor bodies are produced from tubing of S A E 4140 steel having an outside diameter of 2 inches and an inside diameter of 1.686 to 1.688 inches. They are cut to length on an Acme-Gridley automatic, tooled up as shown in Fig. 3. The tubes are fed to length in the sixth position of the machine. The first position is idle. In the second position, a circular form tool on the main slide faces the end and cuts a 30-degree chamfer on the inside of the tube, the work being supported by rollers. In the third position, a circular form tool on the upper side slide starts the cutting-off process, at the same time rounding both the back end of the part and the front end of the tubing which will be cut into the next piece.

A cutting-off tool on a side-head cuts about three-quarters of the way through the tube wall in the fourth position, and a similar tool completes the cutting off in the fifth position.

The motor bodies are now thoroughly cleansed of chips and oil in Detrex degreasing equipment, using trichlorethylene, and are then transferred to the Zagar hydraulically actuated broaching machine shown in Fig. 4. Here a tungsten-carbide ball 1.696 inches in diameter is forced through the part to burnish the internal surface. Although the burnishing ball enlarges the internal diameter by compressing the metal as it passes through the part, the metal springs back following the operation, so that the original diameter of 1.688 inches in maintained. Another degreasing operation is next performed, trichlorethylene again being used as the solvent, after which each tubular piece is given a 100 per cent inspection for wall thickness.

From this inspection, the parts are transferred to the forging department, where they are heated, one at a time, on the Tocco 20-kilowatt induction heating unit illustrated in Fig. 5. The parts are heated to from 1900 to 2100 degrees F. for a width of 1/2 inch, the center of the heated band being 6 inches from the upper end of the tube as it is placed in the heating coil.

The heated tube is transferred immediately to

3.5-INCH ROCKETS

Motors for Rockets Must Pass Stringent Hydrostatic Tests when Completed. Therefore Forging, Machining, and Heat-Treating Operations Must be Closely Controlled

By CHARLES O. HERB

U. S. Army photo

An American Army team mans a rocket launcher somewhere in North Korea

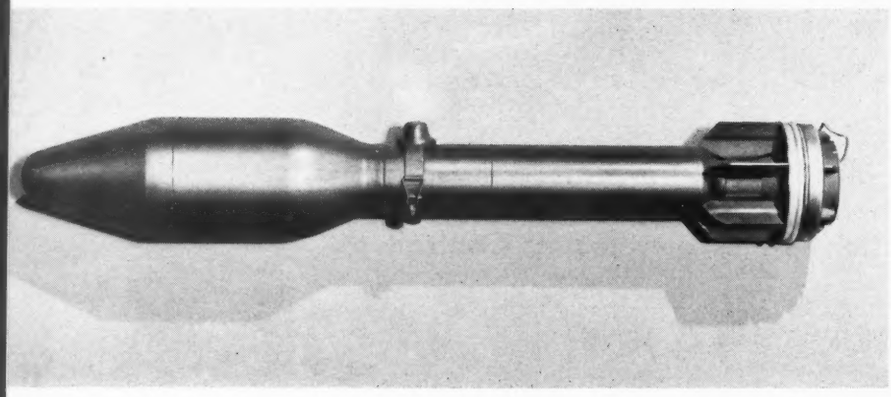


Fig. 1. Assembled view of a 3.5-inch rocket consisting of a "war head" containing explosive, and a "motor," loaded with propellant that drives the rocket

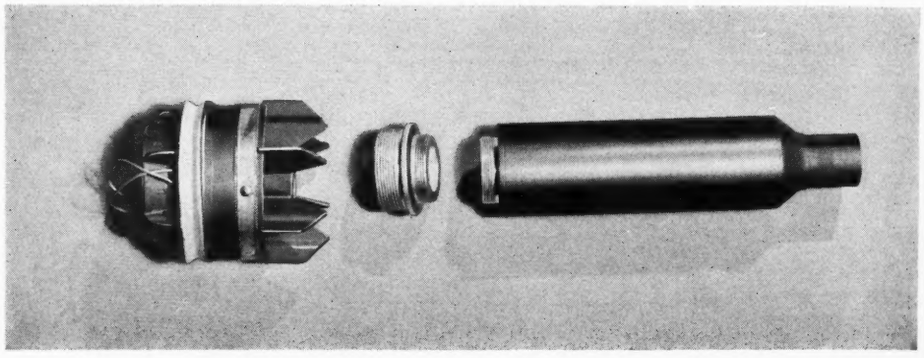


Fig. 2. Tail fin assembly, closure plug, and motor body, which make up the motor for 3.5-inch rockets

Fig. 3. The first operation in the manufacture of rocket motors consists of cutting steel tubing to length in the six-spindle automatic illustrated

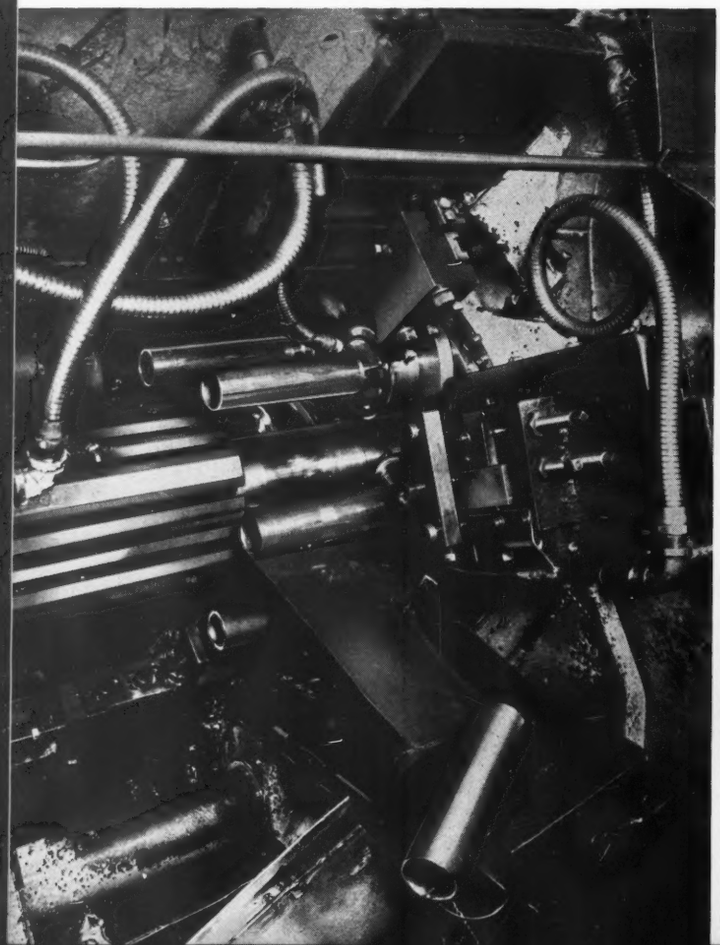


Fig. 4. A tungsten-carbide ball is forced through each piece of tubing on a hydraulically actuated machine to burnish the internal surface

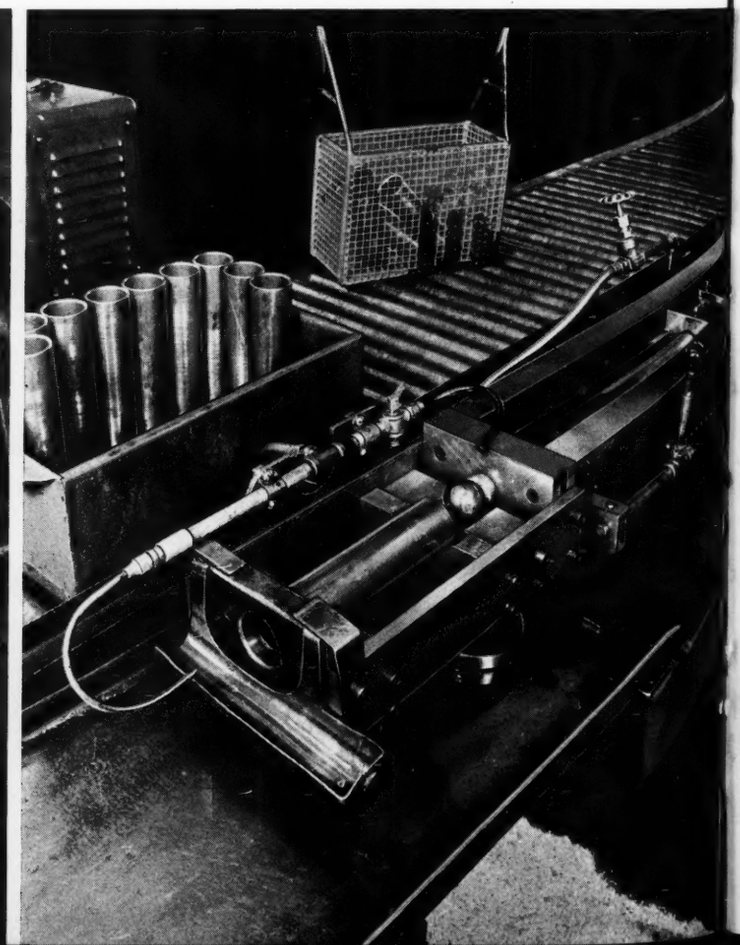


Fig. 5. The tubes are heated locally on electrical induction equipment preliminary to forging a "trap seat" on the inside

the mandrel on a slide mounted on the bolster of the Federal press shown in Fig. 6. The workpiece is brought directly under the die in the press ram by pushing the slide toward the column of the machine. When the ram descends, a "trap seat" is formed on the inside of the tube, as seen at *B*, Fig. 7, the metal being upset between a recess on the mandrel and a shoulder on the punch insert in the center of the die.

Following this operation, the motor bodies are placed successively in a second Tocco induction heating unit and heated for a distance of 2 1/8 inches from the trap-seat end. Again a temperature of from 1900 to 2100 degrees F. is used. Then the heated end is forged to an 11-degree taper, as indicated at *C*, Fig. 7, in a medium-size mechanical press.

The forgings are next degreased and pickled. Degreasing is accomplished by immersion for five minutes in a solution of Oakite No. 24, which is used in the proportion of 8 ounces to 1 gallon of water. This solution is held at a temperature of 196 degrees F., which is the boiling point in Littleton, Colo. The parts are then rinsed in boiling water and next pickled in a solution of Oakite No. 32 (1 gallon to 3 gallons of water) which is maintained at a temperature of 120 degrees F. The parts remain in this solution from ten to fifteen minutes, after which they are again rinsed in boiling water.

The motor bodies are now placed in a Tocco unit again and heated for a distance of 2 1/8 inches from the tapered end at the forging temperature previously used. They are then immediately transferred to the Verson 90-ton press shown in Fig. 8 for forging the venturi, as shown at the left in this illustration and at *D*, Fig. 7. Good inside finish—an important requirement in this forging operation—is obtained by keeping the forging tools in first-class condition and employing a die lubricant developed by Heckethorn engineers especially for this type of work.

After this final forging operation, the motor bodies are allowed to cool to room temperature, and are then given a cycle anneal in a Lindberg pit type Cyclone furnace capable of operating at

Fig. 6. The "trap seat" is formed on a mechanical press equipped with a work mandrel that is slid in and out under the punch and die

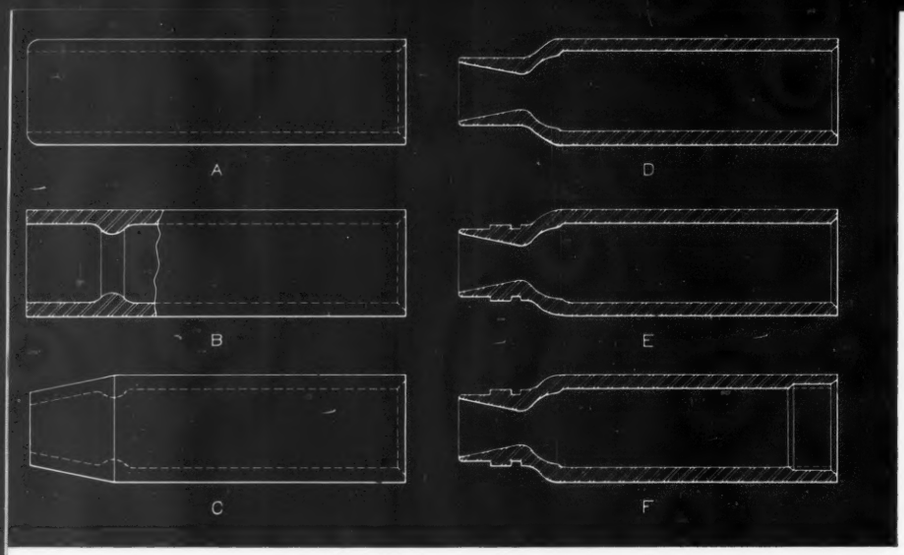


Fig. 7. Diagrams that indicate the successive steps in the forging and machining of the rocket motor bodies

temperatures up to 1400 degrees F. The parts are heated to a temperature above the lowest critical point of the steel, after which cooling is carefully controlled. When the parts leave this operation, the hardness on the venturi end must be between 14 and 18 on the Rockwell C scale, and the hardness of the body proper between 20 and 24.

In this furnace, gases are burned in a chamber away from the work and then mixed in a stream of rapidly circulating gases, which are driven in large volume at high velocity through the charge. The excess volume resulting from combustion is forced out through a flue after passing through the charge. The flue is on the suction side of a fan so that no gases escape except when the burner is in operation.

Following the annealing operation, the parts are again degreased and pickled in a process similar to that already described, except that a rust inhibitor is used in the final rinse. This inhibitor is Oakite No. 24 and is employed in the proportion of 1 ounce to 1 gallon of water. The parts are next 100 per cent checked for surface roughness and to make certain that the throat thicknesses and venturi dimensions meet the required specifications.

The motor bodies are now run through the Cincinnati centerless grinder shown in Fig. 9 for size control to insure that they can be held by collets in subsequent operations. The outside diameter must be between 2.005 and 2.008 inches.

The Acme-Gridley automatic shown in Fig. 10 was converted from a bar machine to a chucking machine by the Heckethorn tool-room for machining the venturi end of the motor bodies as indicated at *E*, Fig. 7. The work-pieces are loaded and unloaded in the fifth position, being fed automatically by a short gravity conveyor. When each part reaches the sixth position, a taper drill on the end tool-slide advances to rough-drill the venturi to an included angle of 31 degrees. In the first position, a second taper-drilling cut is taken on the same surface and a circular form tool on the rear bottom cross-slide turns the throat of the venturi. In the second position, a finish-drilling operation is performed on the tapered hole and a carbide tool on the central rear slide faces the open end of the venturi.

In the third position, a taper drill finishes the inside surface to an included angle of 22 degrees, and at the same time, a circular shaving tool on the upper rear slide finishes the outside of the venturi, leaving an annular ring 3/8 inch wide for knurling. The knurling operation is per-

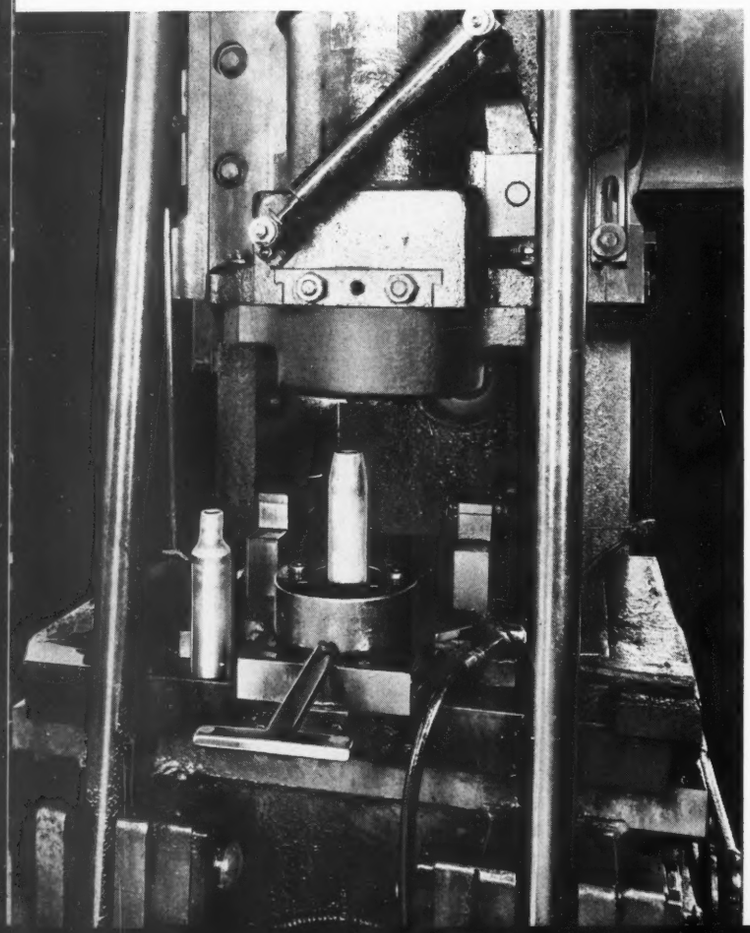


Fig. 8. The third forging operation consists of forming the venturi end, as seen at left, on the tapered section produced in second forging step

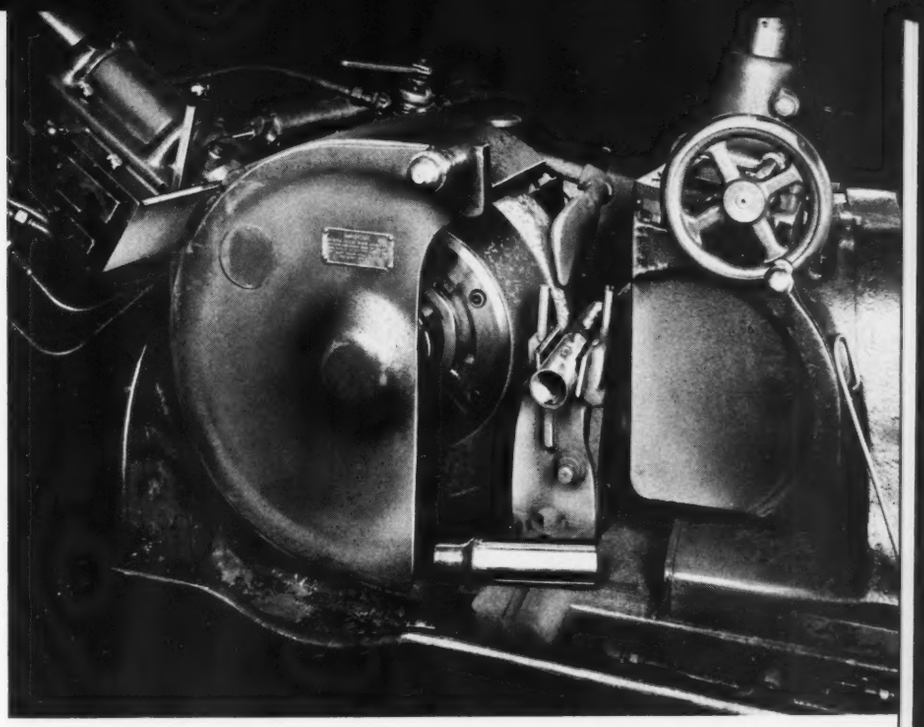


Fig. 9. Following an annealing operation and subsequent degreasing and pickling, the forged motor bodies are run through a centerless grinding operation

formed in the fourth position by a tool mounted on the upper front slide, and at the same time, the portion of the venturi throat that is beyond the tapered surfaces is reamed. The reamer is mounted on the center slide.

Bardons & Oliver turret lathes are tooled up as shown in Fig. 11 for boring the large end of the motor body to the minor diameter of a buttress thread for a length of 3/4 inch. The parts are loaded in the collet by first mounting on the mandrel seen projecting from the right of the turret, after which the turret is indexed to bring the mandrel in line with the collet, and then advanced to feed the work-piece into the collet. The boring-bar, which is seen in line with the headstock in the illustration, is then advanced for boring. Two carbide bits are mounted on the boring-bar, one for boring and the other for cutting a 45-degree chamfer on the inside of the piece. A disk-like pilot supports the boring-bar in the work. A facing cut is taken on the end of the part by a single-point tool on a special cross-slide.

Buttress threads, 1 23/32 inches in diameter, 16 per inch, were previously cut in the same operation by employing the die-head seen mounted on the turret, but these threads are now produced in the Cri-Dan high-speed machine illustrated in Fig. 12. This machine is distributed in the United States by the Lees-Bradner Co. It is equipped with a Kennametal K5H tool bit for the thread-cutting operation. The spindle of the machine revolves at 1000 R.P.M., and the cut is taken at a speed of 84 surface feet per minute. The operation, including loading and unloading, takes twenty-three seconds.

The machine is fitted with a special tool-holder which is swiveled through 90 degrees from the position shown to present the tool to the work for the thread-cutting operation. At the end of the cut, the tool is swiveled back to its previous position, which eliminates the necessity of backing the cutter out of the thread, and thus considerably reduces the time per piece. Following this operation, the parts are again run through

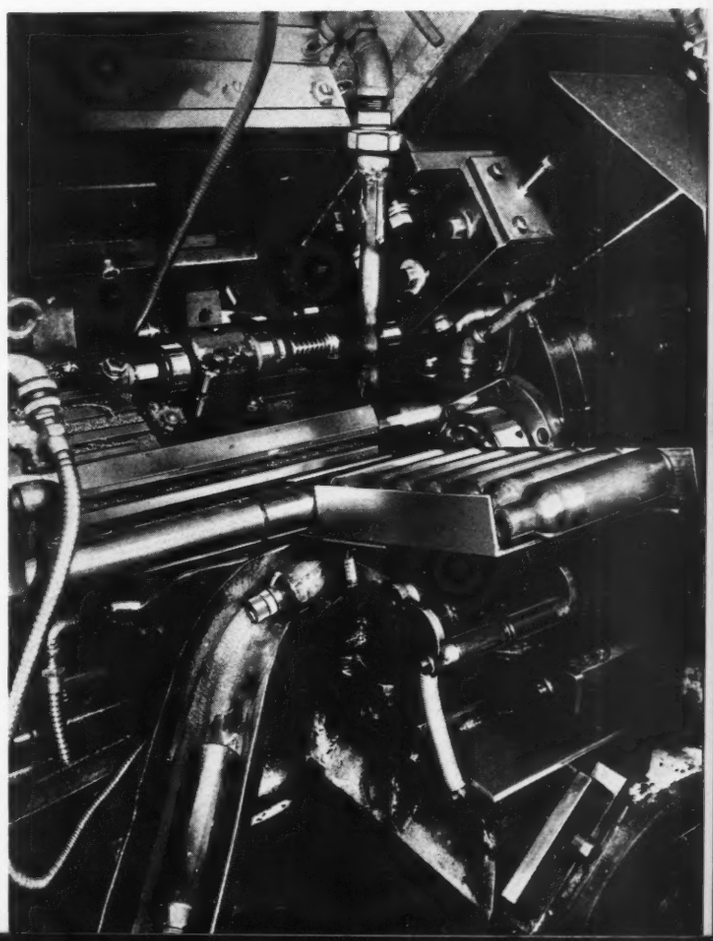


Fig. 10. The venturi end of the rocket motor bodies is completely machined on a six-spindle automatic, the front side of which is shown here

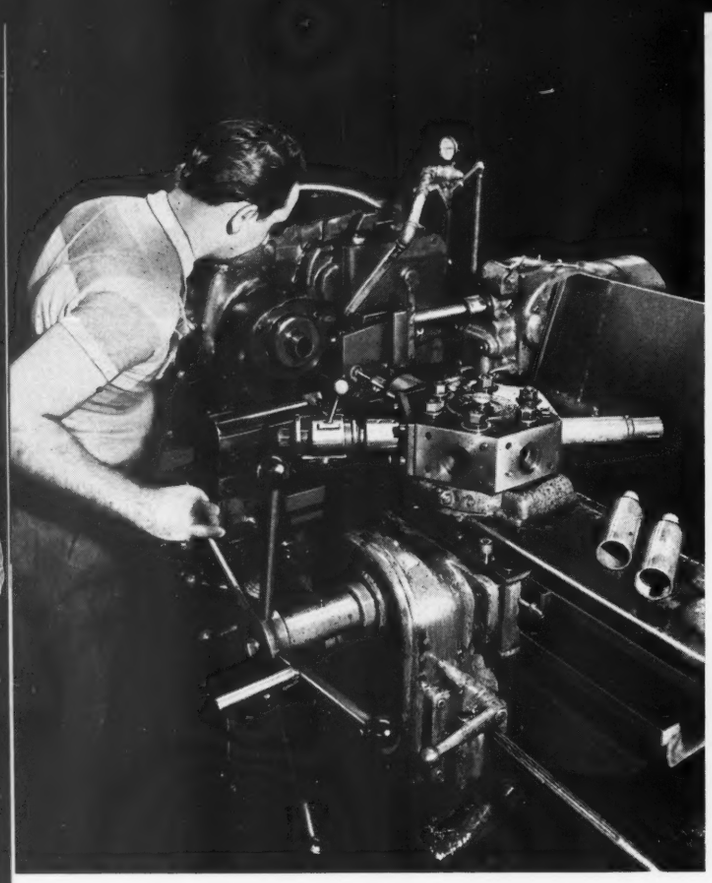


Fig. 11. Boring and facing operation on the open end of the motor bodies is performed on turret lathes equipped with a special side head as shown for the facing operation

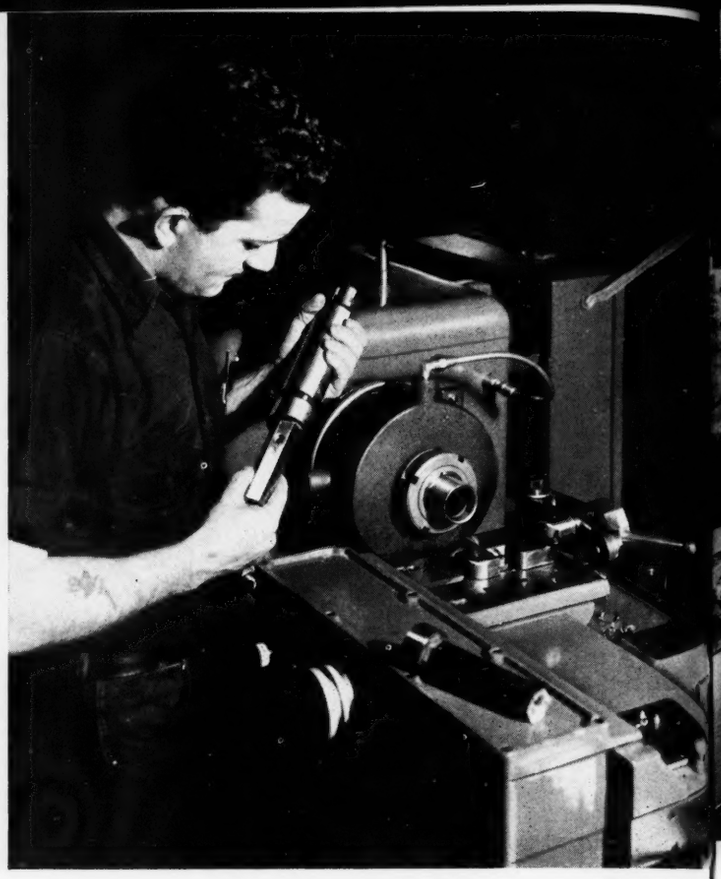


Fig. 12. A buttress thread is cut in the large end of the motor body on high-speed threading machines equipped with a special swiveling type of tool-holder

an eight-minute degreasing operation in Detrex equipment, the cleaning solution being trichlorethylene.

The motor bodies are now subjected to an austempering process, performed with the automatic equipment shown in Fig. 13. The parts are austenitized at 1600 degrees F. in the neutral salt bath seen in the foreground, after which they are quenched at a temperature 45 degrees above the martensite formation point in the next neutral salt bath for 12 minutes, this bath being maintained at a temperature of 600 to 700 degrees F.

Upon withdrawal from this salt bath, the parts are air-cooled to room temperature. Finally, they are immersed in boiling water to remove all salt. Oakite No. 24, which serves as a rust inhibitor, is provided in the water. At this point, two specimen strips are taken from one rocket body out of every five hundred to make

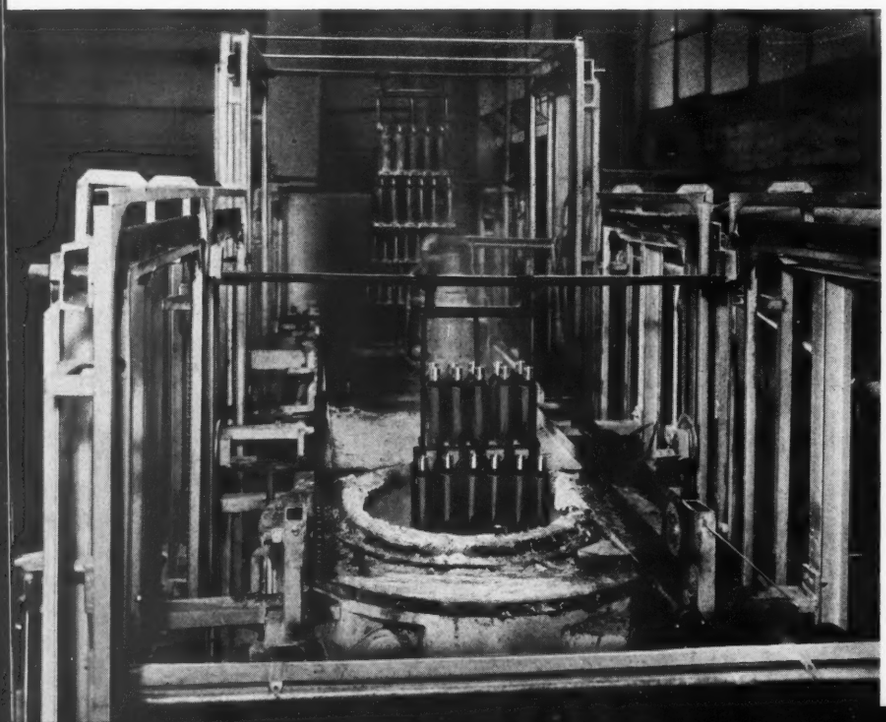


Fig. 13. General view of the heat-treating process which is selected to suit each individual heat of steel

Fig. 14. Carbide-tipped counterbores are used in a six-spindle drilling machine for finishing the trap seat on the inside of the motor bodies

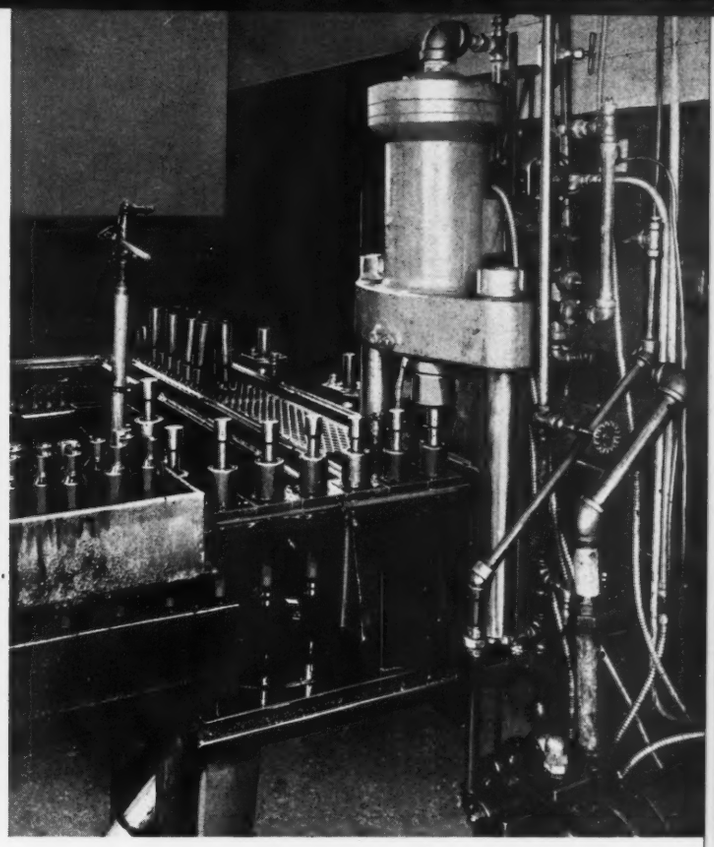
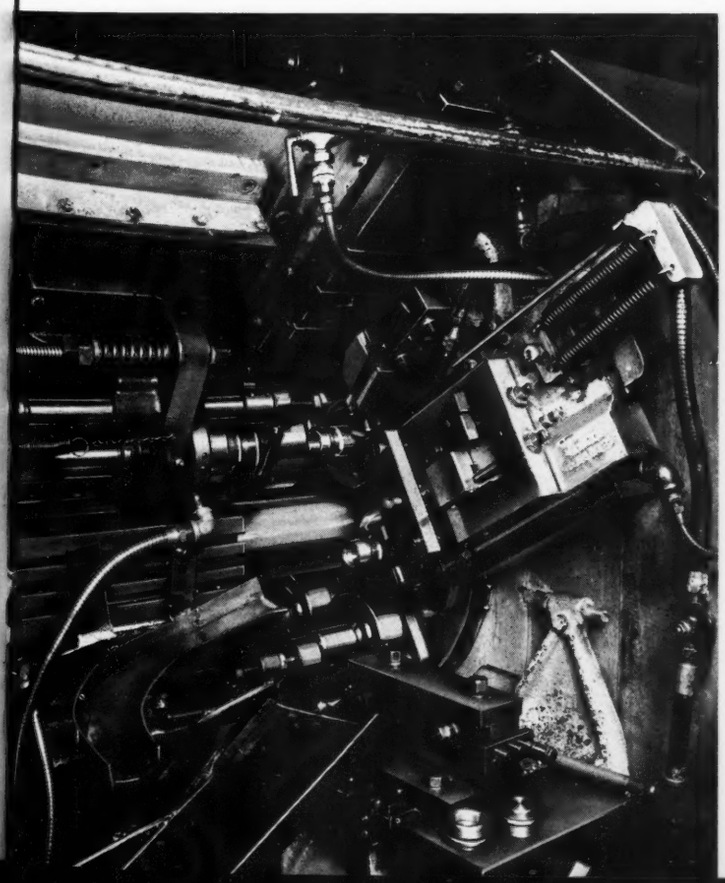
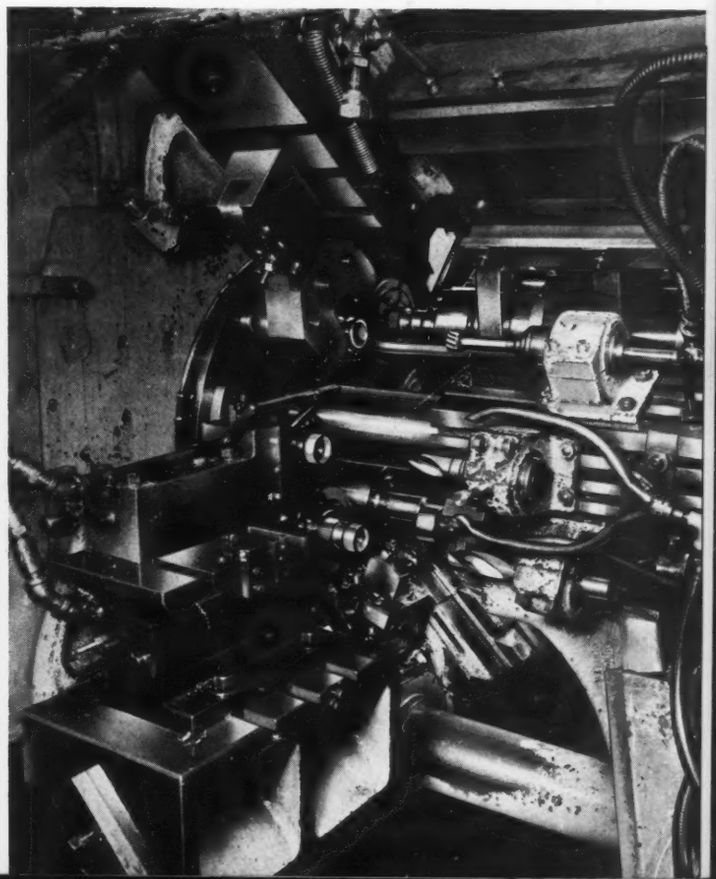


Fig. 15. Each motor body must undergo two hydrostatic tests, forty-eight hours apart, to prevent any possibility of rupture in the rocket launcher

Fig. 16. The motor closure plugs are produced from bar stock in a six-spindle automatic, the front side of which is shown

Fig. 17. Rear view of the automatic that produces the closure plugs, showing at the top the tooling for rolling the V-thread





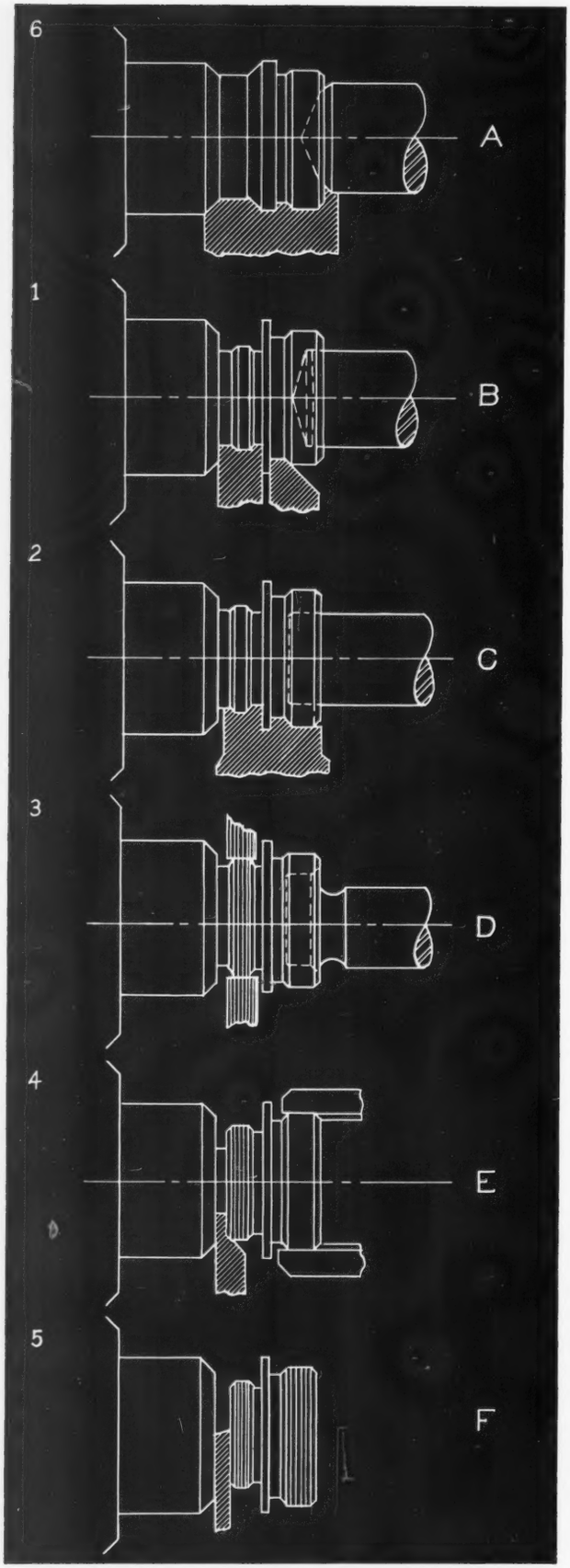


Fig. 18. Diagrams which show the operations performed in the succeeding positions of the automatic in Figs. 16 and 17

certain that the parts are meeting the specified physical properties.

Carbide-tipped counterbores are next used on the six-spindle Natco machine seen in Fig. 14 for machining the trap seat to a diameter of 1.690 inches. Very seldom, however, is metal actually taken from the inside of the body beyond 3/8 inch above the seat because of the satisfactory results obtained with the ball burnishing operation previously described. Dial gages are used to check each part as it comes from this operation. Three quick-acting vises of special design hold two parts each for the operation.

A general view of the special equipment previously employed for the hydrostatic testing of the motor bodies is shown in Fig. 15. Each motor body is loaded into a special fixture and filled with oil to a specified height; then a loose plunger is placed in the motor body above the oil. Next, the body is placed beneath the ram of the hydraulic press seen in the illustration and subjected to a pressure of 25,000 pounds per square inch, which is maintained for three seconds. A soluble oil is used in this test, so as to facilitate thorough cleansing of the part after the operation. Two hydrostatic tests are performed on each body, there being an interval of forty-eight hours between the two tests. A new machine constructed for performing the tests on a semi-automatic basis will soon be installed. Thus the operation will be speeded up materially.

The motor bodies are next subjected to a degreasing operation. In this process, Pentasol, in the proportion of 6 ounces to 1 gallon of water, is employed for the solvent. The cleaning solution is maintained at a temperature of 180 degrees F. and the parts are immersed in it for five minutes. Two rinsing operations follow the degreasing, the first being a cold water rinse, and the second a hot water rinse, with the water heated to 140 degrees F.

Bonderizing is then performed with a compound known as "Bonderite No. 160," which is used in the proportion of 2.87 pounds to 1 gallon of water. The temperature of the solution is 180 degrees F., and the parts are held in it from four to six minutes. Next the parts are rinsed in cold water, after which they are submerged in a chromic phosphoric acid solution (Parcolene) which is used in the proportion of 2 cubic centimeters to 1 gallon of water. This bath is maintained at a temperature of between 120 and 140 degrees F., and the parts are immersed for one minute. They are dried in hot air. Following this operation, the bodies, including the

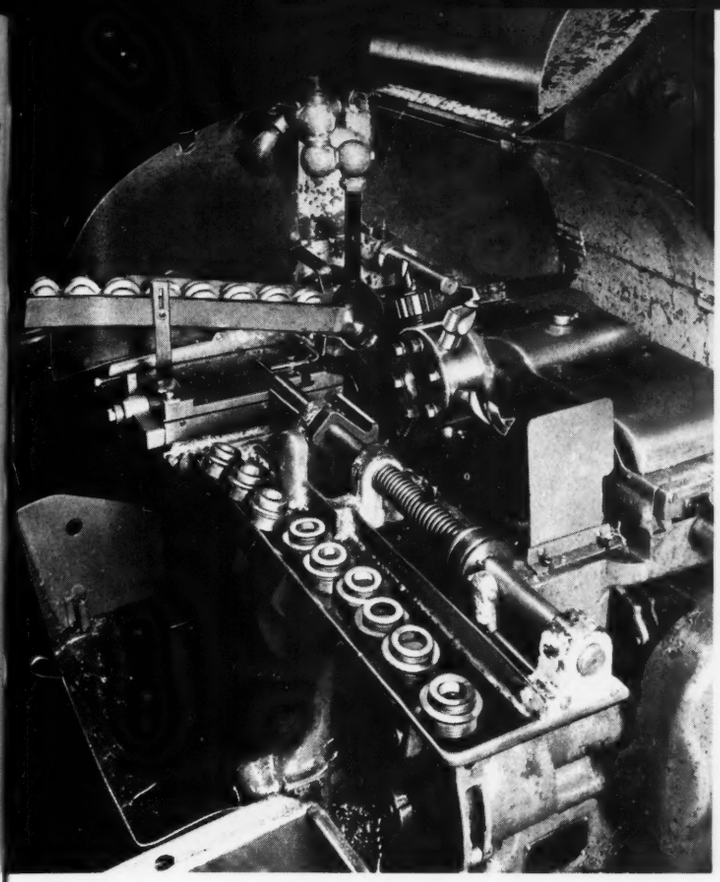


Fig. 19. Single-spindle automatic employed for drilling, boring, and counterboring the smaller end of the closure plug

Fig. 20. Close-up view of one of the welding operations that are performed in putting together the tail-fin assembly

threads, are coated inside with an ethylcellulose lacquer.

The motor closure plugs are produced from 2-inch round cold-rolled stock in a 2 5/8-inch Acme-Gridley automatic, Figs. 16 and 17. Finished plugs are seen lying at the front of the machine in Fig. 16. The stock is fed to a stop in the sixth position of the machine, after which a 1 1/2-inch drill on the end slide advances to spot-drill the end of the bar. At the same time, a circular form cutter on the lower front slide advances to machine the end of the bar, as indicated at *A*, Fig. 18.

In the first position, a circular form cutter and a single-point cutter produce grooves in the piece, as shown at *B*, the cutters being mounted on the rear bottom cross-slide. At the same time, a 1 15/64-inch drill on the end slide enlarges the drilled hole in the end of the piece.

In the second position, a shaving tool on the rear cross-slide finish-forms the irregular contour of the piece as indicated at *C*. Simultaneously, an end-mill cuts a flat seat in the bottom of the hole. In the third position, threads are rolled on one end of the part by a set of thread rolls mounted on the top rear slide, and at the same time, the hole in the opposite end of the piece is bored with a tool on the end slide, these operations being indicated at *D*.

A buttress thread is cut on the large end of the piece by employing a die-head mounted on

Fig. 21. Riveting the contact and ground wires to the tail-fin assembly

Fig. 22. Pushing the extension nozzle of the tail-fin assembly over the venturi end of the motor body

the end slide when the part is in the fourth position, and at the same time, the opposite end of the piece is chamfered with a single-point tool on the front upper slide, as indicated at *E*.

Finally, the part is cut off in the fifth position, as indicated at *F*. Fig. 16 shows the tooling of the fourth, fifth, and sixth positions, while Fig. 17 shows the tooling mounted in the first, second, and third positions.

As the closure plugs come from the automatic, they are routed to two Brown & Sharpe No. 2G automatics, tooled up as illustrated in Fig. 19. These machines perform successive drilling, boring, and counterboring operations on the smaller end of the closure plugs. Finished pieces may be seen lying on the tray at the front of the machine. Two of these automatics are located at right angles to each other, so that one attendant can conveniently keep the work chutes of both machines loaded. The motor closure plugs are next degreased in a trichlorethylene solution, and then flash-plated with cadmium.

A hydrostatic test is next applied to the parts, using a pressure of 18,000 pounds per square inch. Then a disk is assembled in one of the counterbores of the closure plug, after which the plug is lacquered completely in the bores.

Next the closure plug is assembled in the large end of the motor body, after which the assembly is painted olive drab all over, with the exception of the threads on the closure plug.

The tail fin assembly of the rocket is made up of several aluminum stampings, including an extension nozzle, which has a shank that fits over the venturi of the motor body, and three fin stampings, each of which has two fins. There is also a support ring with copper contact band and insulator ring. The fins and the support ring are welded to the extension nozzle by employing Sciaky three-phase "Modu Wave" welders. The support ring is also welded to the tail fin assembly on the same machines.

A close-up view of one of these operations is shown in Fig. 20. The machines are equipped with electronic timers. High speed of operation is obtained through the provision of an air-operated diaphragm type of pressure chamber for actuating the welding ram.

Live and ground wires are riveted to the tail fin assembly as shown in Fig. 21. One of the final operations is to mount the tail fin assembly on the motor bodies. This is accomplished on a Famco arbor press, as shown in Fig. 22. A helper adjacent to this machine places the tail fin assembly loosely on the venturi of the body, after which the operator pushes the tail fin assembly into place on the machine.

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Small Shops Are Important to the Defense Effort

By CHARLES A. SIMMONS, President
Simmons Machine Tool Corporation
Albany, N. Y.

IN carrying out our plans for national defense, it may become necessary to distribute the work to everyone with manufacturing "know-how" and essential machine tools, even to the smallest shops. In Germany, before and during the last war, every machine tool was used to its full capacity, regardless of where it was located; only by such widespread application of facilities were the Germans able to produce in sufficient volume to conduct a war against nations having a much greater population. The English scattered their war work, under a plan called "Bits and Pieces," over a variety of small shops, including service garages and even home workshops. The results obtained by those nations indicate that these sources of supply should not be overlooked by our country in the present emergency.

There are thousands of machine tools in small plants, universities, and service garages that may stand idle during a war production boom for the reason that their owners do not have the time, money, or contacts for obtaining orders directly from Government agencies. Obviously, the Government set-up for giving out contracts lends itself only to big corporations, for various reasons. Under the "Bits and Pieces" plan, each manufacturing problem could be reduced to its smallest bits. The big contractors would give out sub-contracts for units of tanks, aircraft landing gear, gun mounts, turrets, and other materiel. The sub-contractors could break down the units into their component parts, and many of these components could be made by the really small shops.

Thus, red tape would be cut and there would be a solution of the problem as to how the small operator could obtain contracts for war work. The plan would also solve three basic problems inherent in any military production program: (1) Machine capacity; (2) labor availability; and (3) manufacturing flexibility.

There is no great surplus of labor today. The "Bits and Pieces" plan would make it possible to utilize handicapped veterans, retired men, and others whom industry does not generally hire on a long-term commitment. Small operators do not have the personnel problems of large corporations.

The "Bits and Pieces" approach to manufacture would also allow greater flexibility in equipment planning for military purposes. Changing a design always presents problems to the larger shop, whereas minor changes in a component can be made easily by small operators.

An intangible advantage of the idea is the elimination of red tape. A big company would handle negotiations for the entire job, and the Government could be left out of the sub-contract picture entirely. The sub-contractor could be paid weekly upon the receipt of invoices, and in the case of errors or rejected work, credits could be made on the next invoice.

In detail, how would the plan be carried out? Suppose a company obtains a Government order for building gun carriages. The carriages are made up of forgings, castings, structural shapes, strip steel, nuts, bolts, spacers, and hundreds of other components. Many of the parts involve simple machining. The contractor breaks down the production problem into "Bits and Pieces." Then it advertises to the small shops and operators or contacts them through whatever means is most effective. The contractor shows what the part looks like, gives tolerances, etc., and even suggests a price. It will be found that often small shops are able to quote an even better price for work than that suggested, still making a profit for themselves and, at the same time, simplifying problems for the prime contractor.

Two New Gear Materials

Second of Two Articles Describing the Mechanical Properties of Nitralloy N and Ductile Iron, and How These Materials Can be Used in Manufacturing Heavy-Duty Gears — Abstract of a Recent Paper Presented before the American Gear Manufacturers Association by C. M. Schwitter, Development and Research Division, International Nickel Co., Inc.

THIS article will discuss the properties and application in gear manufacture of the recently developed type of cast iron known as ductile iron—a magnesium-containing gray cast iron in which the graphite is disposed as spheroidal particles instead of the more customary flakes. These spheroids of graphite which, by their shape, permit the material to realize a measure of the potential ductility and toughness of which its steel matrix is capable, are shown in Fig. 1.

It is estimated that 15,000 to 20,000 tons of ductile iron were produced in 1950 for products ranging from snap hooks, weighing about an ounce, to forging hammer anvils, weighing up to 80,000 pounds. Gears are among the parts commercially produced, but so far only on a relatively small scale.

The proposed specifications contained in Table 1 indicate that four types of ductile iron are commercially available. The first is a pearlitic type, supplied generally in the "as cast" condition, in which emphasis is placed on high strength and wear resistance, with just enough ductility to provide some measure of plastic deformation under conditions of overload. The second grade —a pearlitic-ferritic type—sacrifices strength in favor of more ductility. This is also generally furnished in the "as cast" condition.

The third type is a fully annealed ferritic iron, in which 15 per cent minimum elongation is readily obtainable, and which has a yield strength of 45,000 pounds per square inch minimum, and a tensile strength of 60,000 pounds per square inch minimum. The fourth is a special grade similar in strength level to the second, but in which elongation is not generally specified, although it runs about 1 to 3 per cent. This iron

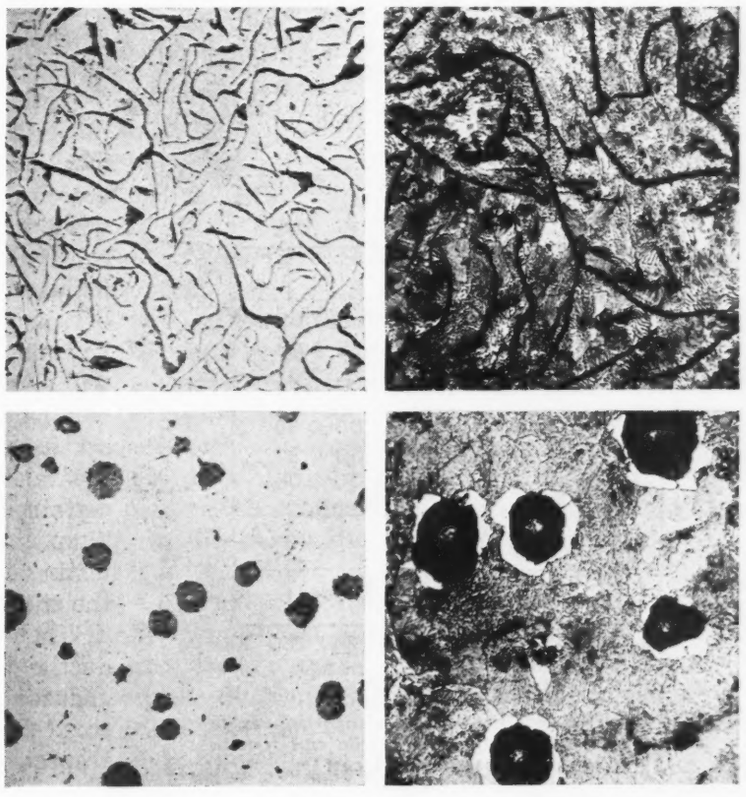


Fig. 1. (Upper Left) Photomicrograph showing flake graphite in gray iron at 100 X magnification. (Upper Right) Flake graphite seen in gray iron at 250 X magnification. (Lower Left) Photomicrograph showing spheroidal graphite in ductile iron at 100 X magnification. (Lower Right) Spheroidal graphite seen in ductile iron at 250 X magnification

Table 1. Proposed Minimum Mechanical Properties for Ductile Iron

Grade	Tensile Strength, Pounds per Square Inch	Yield Strength, Pounds per Square Inch	Elongation, Per Cent	Brinell Hardness Range
90–65–02	90,000	65,000	2.0	225–265
80–60–05	80,000	60,000	5.0	195–225
60–45–15	60,000	45,000	15.0	140–180
80–60–00	80,000	60,000	No Stipulation	230–290

Cast Specimen: 1-inch keel bar cast in dry sand.
Test Specimen: Standard round tensile test specimen, ASTM E-8, with 2-inch gage length.
Yield Strength Measurement: 0.2 per cent offset or by dividers method at 0.5 per cent extension under load.

tolerates a higher phosphorus level, which reduces its ductility and toughness.

These are not the only grades of ductile iron available, but are the ones most widely produced. Other combinations of strength and ductility can be readily achieved, generally according to the relationship established in Fig. 2. Some of these will be illustrated by subsequent data.

Characteristic of ductile iron is its relative insensitivity to changes in section size. In the "as cast" condition, strength and hardness decrease as the section is increased from 1 to 6 inches, but this drop is not as severe as would be expected of flake-graphite gray iron. In the annealed condition, strength in the heavy sections is maintained and is uniform throughout the cross-section; however, elongation values suffer an appreciable drop. This is attributed to inability to anneal the material so as to produce a completely ferritic structure in the cores of heavy sections, but this problem is being studied, and does not appear to be insurmountable.

The ultimate compressive strength of gray

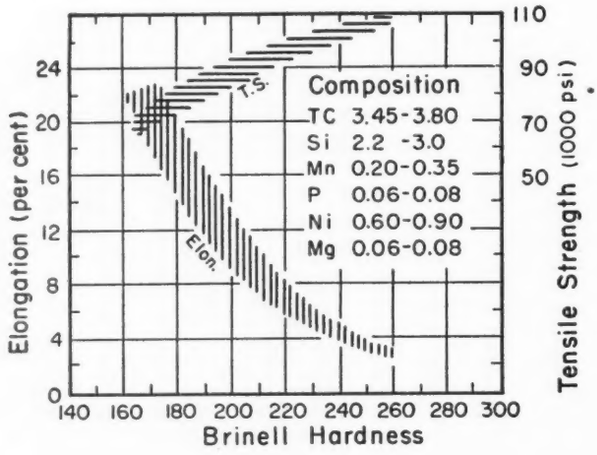


Fig. 2. Relationship between elongation, tensile strength, and hardness of ductile cast iron in 1-inch sections "as cast"

iron is very high in proportion to its tensile strength, a ratio of 3 1/2 or 4 to 1 being the general rule. The compression characteristics of ductile iron, as might be predicted, are neither as high in relation to tensile properties as those of gray iron, nor as low as those of steel.

Ductile iron has a modulus of elasticity of about 25,000,000 pounds per square inch, which is somewhat less than the 29,000,000 to 30,000,000 pounds per square inch generally attributed to steel, but represents a considerable improvement over gray iron, which does not follow Hooke's law. Ductile iron is truly elastic, in the accepted sense, and its modulus is practically unaffected by composition or section thickness. A comparison of the elastic characteristics of ductile iron and gray iron is given in Fig. 3. The curve for spheroidal iron displays the shape attributed also to steel, with true proportionality giving way to a rounded yielding at high stress. Gray iron deviates continuously from a straight line, and it is necessary, for engineering purposes, to measure a tangent to the stress-strain curve at some arbitrarily selected point, generally 25 per cent of the tensile strength.

Another elastic characteristic of interest is damping capacity. The ability to damp out vibrations in machinery that might otherwise build up stresses to dangerous levels or result in noisiness has always been considered desirable. The comparisons between a 0.30 per cent carbon cast steel, a gray iron with a tensile strength of about 30,000 pounds per square inch, and ductile iron shown in Fig. 4 reveal that the ductile iron has much better damping capacity than the steel, although not so good as gray iron of low strength.

Static strength properties are of interest to the designer because they provide him with a set of numbers that he can insert in calculations and thereby arrive at a suitable design. With the wisdom of experience, he is also aware that his calculations are none too good, and accordingly, he inserts into his reckoning an additional number, known as a factor of safety. Metallurgists have not been able to devise convenient tests that will give numbers permitting more accurate calculation of the ability of a material to withstand service conditions, but there are tests that reflect the relative merits of various materials under certain complex stress combinations. So-called "impact tests" are in this class, as is endurance testing under repeated applications of load below the static ultimate strength.

When tested in the form of polished bars, ductile iron has the same proportion between endurance limit and tensile strength as gray iron. It is somewhat inferior to steel in this respect, which not only has a higher endurance

limit, but also a higher ratio of endurance limit to tensile strength.

These results are not very meaningful to the engineer, because he is rarely faced with a service application so exquisitely polished and streamlined in contour as a properly prepared unnotched fatigue specimen. He is generally dealing with rougher surfaces and irregular shapes, into which he cuts grooves or keyways to suit his various purposes. A simple spur gear, for instance, can be visualized as a continuous collection of notches arranged on a periphery, and within the root of each notch may sometimes be still another collection of small notches in the form of tool marks and scratches. Keyways, sharp shoulders, and narrow fillets are often present. Hence, in a relative evaluation of the usefulness of materials under repeated applications of load, the incorporation of a notch in the test piece gives more informative results. Of course, such results give numbers that are accurate only for the particular conditions of the test being made, but as a gage of the relative worths of comparable materials, they serve a useful purpose.

The values for notched endurance limits give a considerably different picture from the tests on polished specimens. All three materials suffer from the effect of the notch. But forged steel, with a relatively high notch sensitivity, suffers most—to such an extent that its ability to carry a repeated load indefinitely is less than that of ductile iron. The latter suffers from the effect of a notch to the same extent as the high-test gray iron, but the higher strength level of the spheroidal iron permits it to retain a definite advantage over the gray iron. Ductile iron is accordingly the best of the lot under these conditions of test. This is a superiority that might be taken advantage of in the factor of safety used for design purposes.

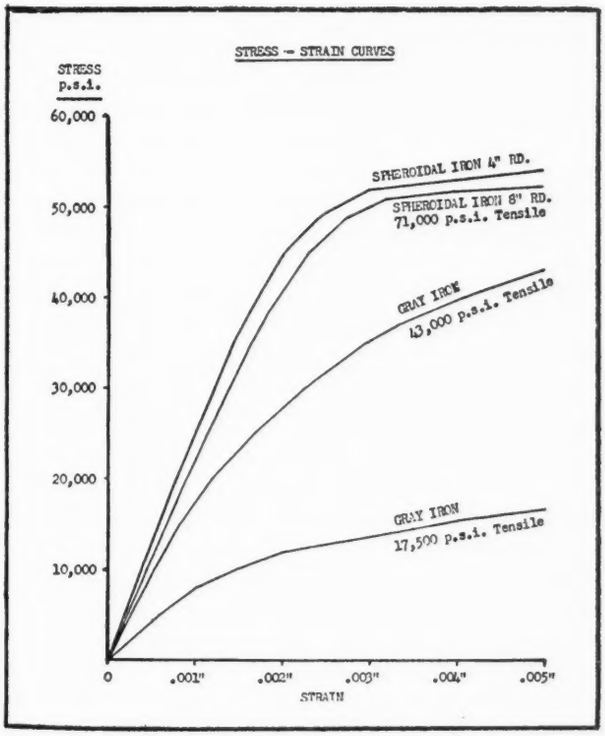


Fig. 3. Comparative stress-strain curves for ductile iron and gray iron

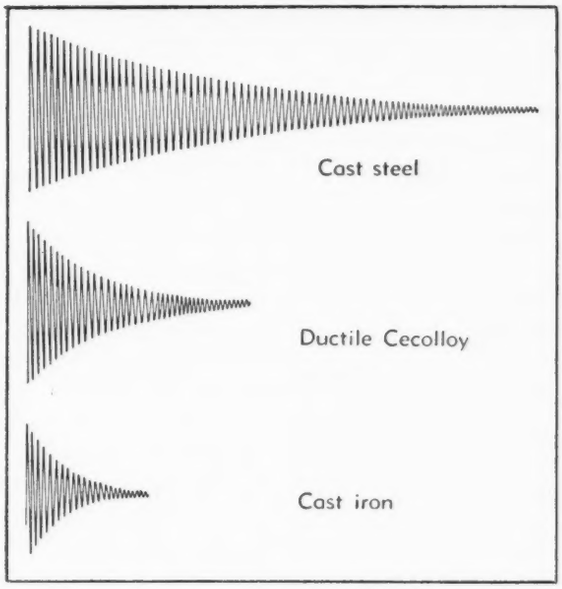


Fig. 4. Curves indicating the relative damping characteristics of cast steel, ductile Cecolloy, and cast iron as obtained on oscillograph recordings of similar specimens

The words "ductility" and "toughness" are often employed in connection with spheroidal cast iron. It will have been observed from the data presented that elongation values accompanying tensile strength figures are high—to the extent that for annealed ductile iron, a minimum of 15 per cent can be safely specified. This, of course, far exceeds the scarcely measurable elongation values obtainable with flake graphite gray iron, and even compares favorably with values for some steels.

Good elongation means that the material, when subjected to a tensile pull, suffers plastic flow and yields measurably before it breaks. It also reflects ability of the material to be twisted and bent, as shown in Fig. 5. This is rather an impressive performance for the product of a gray iron foundry.

Reduction of area values—also a product of the tensile test—are practically zero for gray cast iron, but are a commonly used gage for steel. Such values for ductile iron are indifferently poor, and are generally not reported. They are about equal to the values for elongation. The

apparent discrepancy between good elongation values and low values for reduction of area can be resolved when it is realized that reduction of area is sensitive to the presence and distribution of inclusions, being, in fact, often used as a measure of the quality of steel rather than its ability to withstand deformation.

Ductile iron does not "neck down" in the tensile test, but reduces uniformly over the length of the bar. Whether or not necking, which is responsible for the high reduction of area values for steel, has any practical significance in an engineering structure is speculative. At any rate, the presence of graphite, even though spheroidal in form, makes reduction of area unreliable as a gage of ductility of magnesium-containing cast iron.

The term "toughness" means something else. A material may be ductile, in the sense that it can be bent, twisted, or shaped readily, and yet lacking in toughness in the sense that it resists shock or the application of multi-directional stresses.

Gray cast iron has never been considered to have appreciable toughness, but metallurgists have recognized the desirability of differentiating between the abilities of various irons to resist the application of a sharp blow. A modification of the Izod test is often used, employing an unnotched and unmachined arbitration bar, 1.20 inches in diameter, which is gripped in the Izod vise and struck 3 inches above the support by a swinging hammer with a striking energy of 120 foot-pounds.

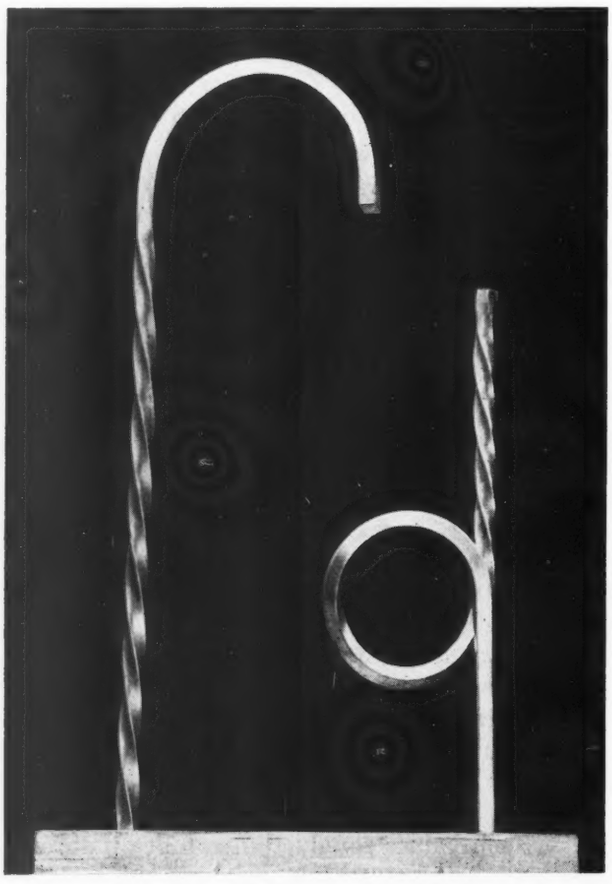


Fig. 5. Twisted specimens of ductile iron pipe

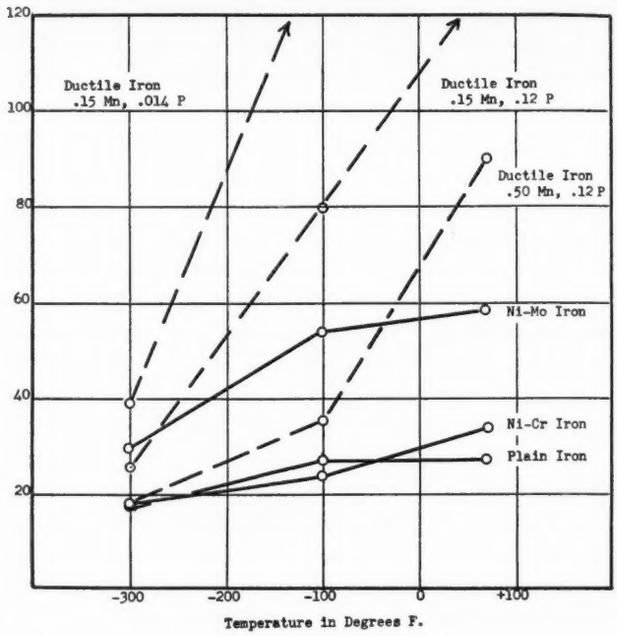


Fig. 6. Relative impact properties, in foot-pounds, of flake graphite gray irons and spheroidal graphite irons as shown by modified Izod test

This test has served adequately to differentiate between irons of brittle nature and those possessing some inherent toughness. The comparative results of such a test, over the range from room temperature down to —300 degrees F., on flake graphite gray irons and several irons containing spheroidal graphite are shown in Fig. 6. The superiority of ductile iron is obvious, and certainly, from the cast iron standpoint, the material has fairly good toughness.

The steel metallurgist, however, uses a much more severe impact test, such as the vee-notched or keyhole-notched Charpy test. On the basis of the vee-notched Charpy test, ductile iron in the "as cast" condition at a hardness of 250 to 270 Brinell yields values ranging from about 2 to 4 foot-pounds; in the annealed condition, these values are considerably improved, ranging from about 9 to 12 foot-pounds. Variations in chemical composition appear to have little effect. There remains to be explored the effect of the matrix microstructure. It is conceivable that suitably quenched and tempered structures may show further improvement.

Although such impact values are not up to the standards set by properly heat-treated steels, they are no worse than are occasionally encountered in some cast steels. It must be borne in

Table 2. Unnotched Charpy Tests of Four Ductile Iron Heats

Iron No.	Chemical Composition						Tensile Strength, Pounds per Square Inch	Elongation, Per Cent	Unnotched Charpy Impact, Foot-Pounds	
	C	Si	Mn	P	S	Mg			Room Temp.	Minus 40 Deg. F.
1	3.23	2.56	0.41	0.062	0.014	0.080	71,500	21.5	50–70	41–52
2	3.36	2.62	0.41	0.058	0.017	0.082	72,500	16.0	43–31	22–51
3	3.54	2.52	0.41	0.054	0.013	0.088	70,500	15.0	57–72	40–42
4	3.56	2.80	0.42	0.086	0.016	0.094	72,500	26.0	68–84	16–41

All irons in the annealed condition. Specimens machined from 1-inch keel blocks.

mind that the matrix of ductile iron in the pearlitic condition approximates that of steel of eutectoid (0.85 per cent) carbon content. Such steels are seldom noted for high toughness, even in a softened condition.

The results of unnotched Charpy tests are given in Table 2. These values for four irons, ranging from 31 to 84 at room temperature and from 16 to 52 at minus 40 degrees F., compare favorably with values for such steel products as road-scraper blades, which are commonly used in the rolled condition and are often required to withstand shock in service.

Of course, the crux of the matter is to determine which type of test more nearly approximates service demands before deciding whether a given material has sufficient toughness to do the job. Obviously, this can be done only by considering each application as a special case. Even then, experience to be gained by trial and error may be the only reliable guide. Many applications for which gray cast iron is unsuited need only a material with some small ability to deform plastically under load in order to withstand service conditions successfully.

A property that is always of vital importance in a gear material is its resistance to wear or to scoring or galling. Laboratory test data were developed by means of ductile iron specimens shaped like brake shoes, pressing against a standard gray iron drum 3.5 inches in diameter and rotating at 1750 R.P.M. A 5-pound load was

Table 3. Wear Tests on Ductile Iron

	Heat No. 1	Heat No. 2			Heat No. 3
Specimen Number ..	1	2	3	4	5
Specimen Wear, Milligrams	10.9	7.2	7.3	6.2	9.8
Drum Wear, Milligrams	62.1	89.0	87.3	101.0	68.3
Total Wear, Milligrams	73.0	96.2	94.6	107.2	78.1

Specimens in "as cast" condition.

Table 4. Comparative Gall Test Data for Ductile and Gray Cast Irons

Type of Iron	Type of Graphite	Composition, Per Cent							Tensile Strength, Pounds per Square Inch	Brinell Hardness Number	Scoring Load, Pounds	Galling Load, Pounds
		C	Si	Ni	Mn	P	S	Mo				
Gray	A.F.S. Type E, Dendritic	3.1	1.7	2.0	0.8	0.09	0.09	...	30,000	224	150	190
Gray Inoculated	A.F.S. Type A	3.0	1.8	2.7	0.7	0.09	0.09	...	36,000	218	300	400
Gray High Phos.	A.F.S. Type A	3.1	1.7	2.1	0.7	0.46	0.13	...	47,000	241	375	560
Acicular Gray	A.F.S. Type A, Coarse Flake	2.6	1.7	2.0	0.9	0.09	0.08	0.7	65,000	302	1000	None
Ductile	Spheroidal	3.0	1.7	1.9	0.9	0.02	0.01	...	90,000	279	400	500
Ductile (High C, Low Mn)	Spheroidal	3.5	2.3	2.0	0.2	0.02	0.01	...	.....	212	400	500

The method of test consists in oscillating a cylindrical specimen through an angle of 15 degrees by pressing the cylindrical face against an annular flat specimen and, at the same time, continuously increasing the load until considerable galling is evinced.

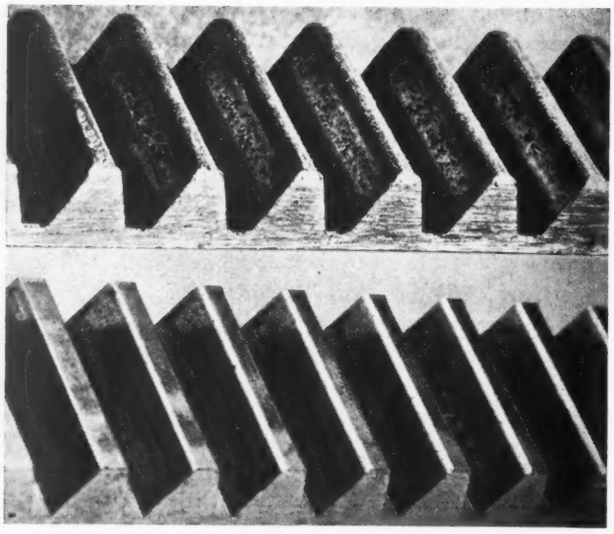


Fig. 7. Comparison of gear racks after a 1500-hour test at 50 per cent overload. The specimen shown in the upper view is forged steel (Type X1335 manganese steel), while that in the lower view is ductile iron

maintained between specimen and drum for the duration of the test, which was one hour. No lubrication was used, and wear was reported in milligrams of weight loss. Results obtained with five specimens representing three heats are indicated in Table 3. Specimens 1 and 5 were softer than the other irons; they ranged from 95 to 100 Rockwell B and 98 to 101 Rockwell B, respectively. The hardness of the other specimens was in the range of 101 to 106.

It is interesting to note that the softer ductile irons wore at a greater rate than the others, but induced considerably less wear on the drum material. The company making these tests concluded, on the basis of these results, that ductile iron compares favorably in wear characteristics with the best open-grained gray iron made in statically cast pots for piston-ring purposes.

The results of galling tests on ductile iron are incorporated in Table 4. In this instance, the tests consisted in rubbing or oscillating (not rotating) a cylindrical specimen through an angle of 15 degrees while pressing it against an annular flat specimen of the same material, at the same time continuously increasing the load. A distinction is made between scoring and galling; scoring has reference to superficial scratching of the surface, and galling to extensive damage of the surface area—usually to some depth. No lubrication was employed. The results demonstrate the well-known fact that gray irons with coarse flake graphite are considerably more resistant to galling than iron containing fine, dendritic graphite. The ductile irons, of appreciably higher strength but not necessarily higher hardness, appear to show to about the same advantage as the American Foundrymen's Society's Type A graphite irons.

Service data on the subject of wear are much more convincing than laboratory data, since, in many instances, a laboratory cannot accurately reproduce field conditions. One rather excellent service case has been reported which bears mentioning. A steel plant installed some annealed ductile iron bearing halves in table rolls for a hot sheet mill. The bearing was a rectangular block with a U-shaped channel in the center, in which rode the roll journal, about 3 inches in diameter. It was lubricated in service. Ductile iron replaced bronze on alternate rolls; new bronze bearings were installed in the others. The bronze bearings required taking up by shimming four times before they became so thin that they

Table 5. Comparative Machinability of Ductile and Flake Graphite Iron*

Material	Brinell Hardness Number	Ultimate Tensile Strength, Pounds per Square Inch	Elongation, Per Cent	Cutting Speed, Feet per Minute	
				For tool life corresponding to 200 cubic inches of metal removed	For tool life of sixty minutes
As Cast					
Acicular, Flake Graphite Gray Iron....	263	59,700	0	150	160
Ductile Iron	265	97,250	2	200	210
Gray Iron	225	45,000	0	310	280
Ductile Iron	215	93,000	4	310	315
Gray Iron	195	35,000	0	325	320
Ductile Iron	207	84,700	17.5	420	370
Annealed					
Ductile Iron	183	77,000	20	600	500
Gray Iron	100	15,700	0	960	810
Ductile Iron	170	70,000	22	970	680

*U. S. Air Force Machinability Project, 1950.
Criterion of tool life, 0.030 inch land wear; feed (roughing cuts), 0.010 inch per revolution; depth (roughing cuts), 0.100 inch; tool data, carbide (K6) 6-degree true rake; lubricant, none.

were withdrawn from service. During this period, the ductile iron bearings required no shimming whatsoever. It is estimated that ductile iron delivers a service life four to five times longer than bronze at one-third the initial cost.

Another service application is illustrated in Fig. 7, which gives a visual comparison of two gear racks after a 1500-hour test run at 50 per cent overload. The gear against which the racks operate is a high-carbon sintered steel impregnated with copper and having a tensile strength of 85,000 pounds per square inch. The conventional rack material is shown in the top view of the illustration. It is a resulphurized, free-machining type of medium manganese steel. It is used in the "as forged" condition at 200 Brinell hardness. Severe pitting is evident.

The ductile iron rack, on the other hand, shows practically no pitting, and evidences only a burnished appearance on the edges of the teeth. This particular rack had a hardness of 200 to 205 Brinell. It has been established that satisfactory service has been obtained within the hardness range 150 to 200 Brinell. The saving in cost over steel is estimated at 60 per cent, based not only on the lower initial cost of the ductile iron, but also on its superior machinability.

The rather impressive results of machinability tests are given in Table 5. The first group of materials was tested in the "as cast" condition; these are arranged in pairs. Of the first pair, it will be noted that with a high-strength acicular gray iron having a hardness of 263 Brinell, a cutting speed of 150 feet per minute can be developed for a tool life corresponding to 200 cubic inches of metal removed. It will be seen by the final column (for a tool life of sixty minutes, regardless of amount of metal removed) that a cutting speed of 160 feet per minute can be developed. A ductile iron with about the same hardness, much higher strength, and measurable ductility developed cutting speeds of 200 and 210 feet per minute for the two conditions. The improvement is roughly 30 per cent. The second pair of specimens, having lower hardness, are approximately alike in their machining characteristics; of the third pair, which are still lower in hardness, the ductile iron shows strong superiority.

Even more striking are the results on annealed materials, in which two ductile irons with good strength and ductility are compared with soft gray iron having a Brinell hardness of 100 and a strength of only 15,700 pounds per square inch. The last ductile iron in the table is equal to the

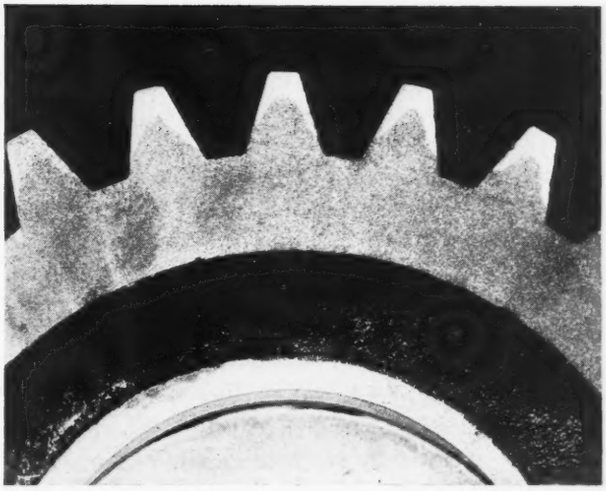


Fig. 8. Flame-hardened sprocket of ductile iron

Table 6. Results of Flame-Hardening Tests on Ductile Iron

Composition						Condition	Hardness			
							Before Hardening	After Hardening	Before Hardening	After Hardening
C	Si	Mn	P	Mg	Ni		Rockwell A	Rockwell A	Equivalent Brinell Hardness Number	Equivalent Brinell Hardness Number
3.66	2.25 Est.	0.16	0.017	0.07 Est.	1.60 Est.	As Cast Annealed	52.0 49.5	81.1 78.9	160 150	610 555
3.46	3.41	0.34	0.044	0.13	0.94	As Cast Annealed	55.0 54.0	81.1 78.0	180 176	610 535
3.84	2.40 Est.	0.74	0.087	0.14	1.00 Est.	As Cast Annealed	54.5 51.0	79.5 78.4	178 160	570 540

Full transformation, 0.06 inch depth; heat-affected zone, 0.20 inch depth; temperatures obtained at the surface, 1500 to 1650 degrees F., approximately.

Equipment Used and Conditions of Test—Airco No. 16 Radiagraph to carry torch; Airco Style 56, 3/4-inch flame-hardening tip. Quench water, 0.3 gallon per minute at 55 to 60 degrees F. Tip to work distances and torch speed, 1/2 inch and 5.5 inches per minute, and 5/8 inch and 5.0 inches per minute. Gas pressures and flows, C_2H_2, 11.5 pounds per square inch gage and 74 cubic feet per hour; O_2, 12.0 pounds per square inch gage and 80 cubic feet per hour.

soft iron by one criterion, and not too inferior by the second.

Limited investigation has been made of the flame-hardening characteristics of ductile iron. The results of tests given in Table 6 were made under the sponsorship of the Bayonne Research Laboratory by the Air Reduction Co. The samples comprised 8-inch lengths of 1-inch square material cut from keel blocks. Both "as cast" and annealed materials were studied. Compositions and all pertinent processing data are given in the table.

The annealed material generally developed a lower surface hardness than the "as cast" samples, but apparently is quite capable of meeting a hardness range of 530 to 550 Brinell. The "as cast" material developed a hardness of 610 Brinell, except in the case of the high-manganese iron, which developed a hardness of 570 Brinell.

These tests were carried out at relatively low torch speeds. Variations were made in tip distance and torch speed within the limits indicated in the table; these were not enough to produce any changes warranting comment.

A practical application of flame-hardened ductile iron is illustrated in Fig. 8. The flame-hardened areas of the teeth are evident. This is a chain sprocket which encounters service not unlike that of a gear. According to file tests, the hardened surfaces are within the range of 58 to 61 Rockwell C. Dynamometer tests of these sprockets are in progress; tentative conclusions are that performance is excellent. Flame-hardened ductile iron wears smoothly, while gray iron hardened by the same method forms pits.

As observed at the beginning of this article, ductile iron is a new material. This discussion of its characteristics is not complete, but it comprises almost all of the information available to date which might bear on its application for gears. Commercial gear applications are not many; aside from those described, the only others known are the use of ductile iron gears for certain parts of agricultural implements and the use of ductile iron in some intricately machined marine gears.

The data presented indicate, in general, that magnesium-containing cast iron is a material which partakes in fair measure of the better qualities of both gray iron and cast steel. It is being used as a replacement for existing materials in many parts, and there appears to be no reason why certain types of gears should not be included in the list. However, it would be shortsighted to view this material simply as a replacement for existing materials. Ductile cast iron can be as readily cast as gray iron, with no limitations on size. It has measurable ductility, and in many instances approaches the properties of cast steels.

These characteristics have already permitted commercial production of designs that hitherto existed only on drawing boards because, although they required properties commonly associated with steel, they were too intricate to be cast in other than gray iron. Thus ductile iron can be utilized to redesign existing parts and also to create entirely new designs.

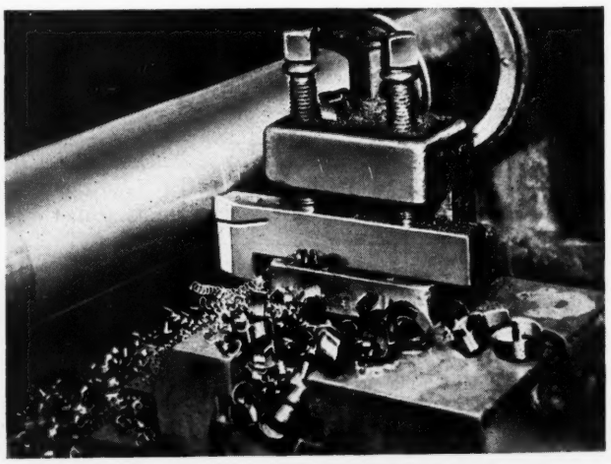
[In the first installment of this article, published in December MACHINERY, it was stated on page 181 that "one manufacturer engaged in an investigation of this steel is aiming to hold the accuracy to 0.001 inch per inch. . . ." This should have been 0.0001 inch.—EDITOR]

* * *

Chromium-Plated Tool-Holders Applied to Tough Operating Conditions

The new line of chromium-plated, ejector type tool-holders, recently announced by the Super Tool Co., Detroit, Mich., demonstrated their ability to stand up under tough operating conditions when applied to the production job illustrated. This job consists of turning high-carbon alloy-steel shafts 6 inches in diameter to 5 1/4 inches in diameter at a surface speed of 400 feet per minute.

Tool-holders previously used on this job failed because of heavy chip erosion, which destroyed the holder even before one carbide insert was used up. When the chromium-plated holders were used, after turning the equivalent of twenty-two miles of chips, they appeared to be as good as new. Use of these holders on another job requiring interrupted cuts on the flanges of cast-iron housings resulted in a reduction in tool costs of approximately 70 per cent.



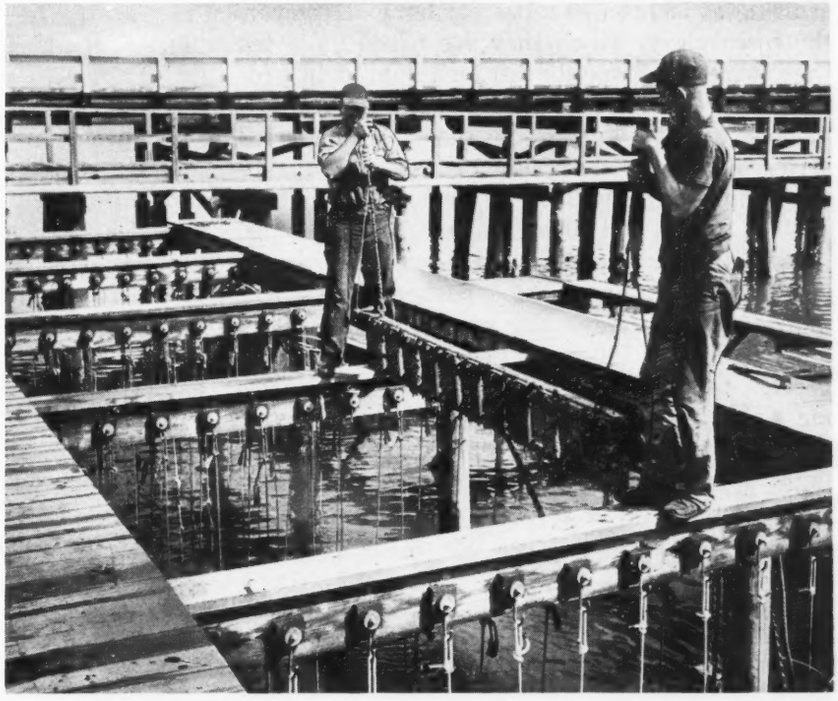
Turning high-carbon alloy-steel shaft with carbide insert held in new chromium-plated ejector type holder

New International Nickel Corrosion Testing Station

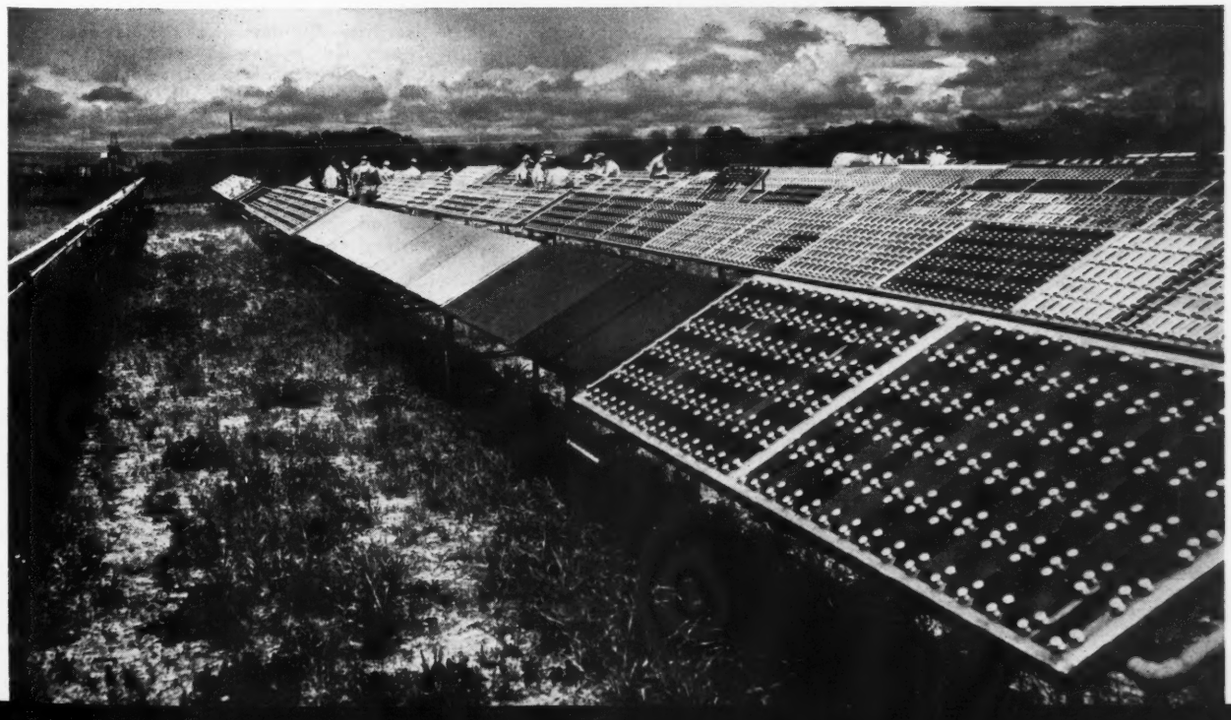
REPRESENTATIVES of more than one hundred industrial companies and Government officials attended the formal opening on November 15 and 16 of the new Harbor Island addition to the Kure Beach corrosion testing project of the International Nickel Co., Inc., near Wilmington, N. C. With the new laboratory and marine exposure racks, the project now has facilities for studying over 20,000 specimens of all types of materials in sea water and sea air. It is one of the largest projects of its kind in the world.

The sea water tests were established at Kure Beach in 1935 and moved this year to the new station at Harbor Island about twenty miles north. The atmospheric testing lot, covering over an acre of ground, is still located at Kure Beach, as is a station about eighty feet from the shore line for testing the effects of sea water spray. Specimens of metals, alloys, non-metallic materials, protective coatings (including paint), and even rope are under test.

Manufacturers of competitive products cooperate in this study of corrosion, and information about corrosion is freely exchanged. Much of the research is directed toward the solution of corrosion problems for the Government.



(Right) Lifting a Monel rack having specimens of marine growth on it from sea water at the Harbor Island, N. C., corrosion testing laboratory of the International Nickel Co., Inc.



(Below) General view of the atmospheric test lot at Kure Beach, N. C., where the effects of corrosion from sea air on many different kinds of specimens are observed

Engineering News

New Aircraft Propellers May Result in Speeds of 1000 Miles an Hour

An advanced series of subsonic, trans-sonic, and supersonic propellers, which will pave the way to the eventual attainment of speeds up to 1000 miles per hour with long-range, propeller-driven bombardment, troop-carrying, and transport aircraft, has been developed by the Curtiss-Wright Corporation, Caldwell, N. J. Initially, the propellers will be used in aircraft capable of cruising at 500 to 600 miles per hour. However, the research on which they are based indicates that twice these speeds can be achieved in propeller-driven aircraft of the future. The new models will be known as the "Turbolectric" series. They are designed for use with turboprop engines in the 2500 to 5000, 5000 to 7500, 7500 to 10,000, and 10,000 to 20,000 H.P. ranges.

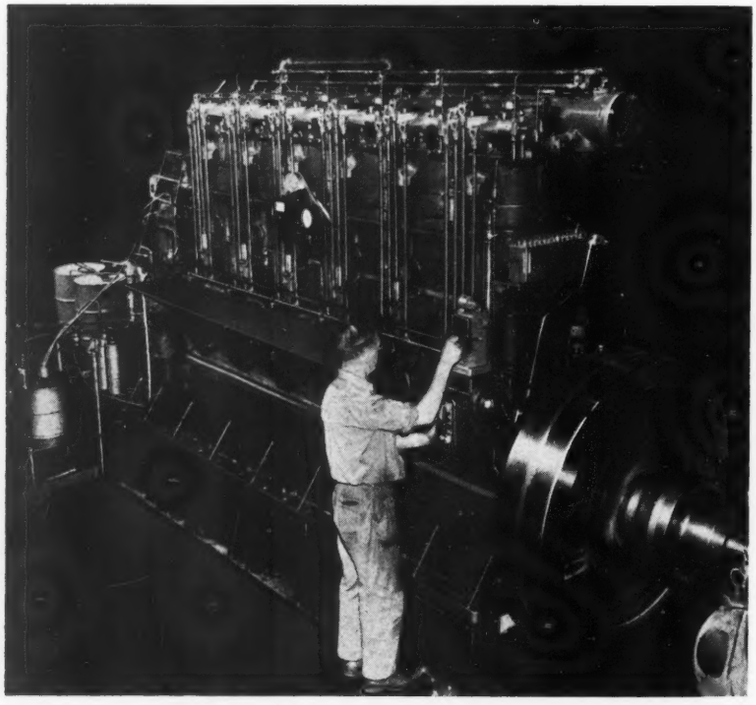
Used in combination with these super-power gas turbine engines, the "Turbolectrics" will immediately increase the performance of aircraft by 100 to 150 miles per hour over that of present-day propeller-driven military and commercial types. At the same time, the economy of fuel consumption, control features, and over-all flight efficiencies of today's piston engine-powered aircraft will be retained or improved.

All of the "Turbolectrics" are of the constant-speed type, and can be feathered to reduce drag in event of engine failure and reversed for use as an aero-dynamic brake to shorten landing runs. Models of these new propellers are now on test by the Air Materiel Command of the Air Force at Wright-Patterson Air Force Base. Among the first military installations will be the application by the Air Force of "Turbolectrics" to the turbo-prop version of the Douglas C-124 troop- and cargo-carrying transport.

"Drop Ball" Impact Test Shows Resilience of Rubber-Phenolic Plastics

A special impact test designed to reflect the unusual resilience of G-E rubber-phenolic plastics to repeated shock has been developed in the Chemicals Division of the General Electric Co. Standard Izod or Charpy impact tests do not give a true indication of the resilience of these compounds. With the new "drop ball" test, by careful selection of the height from which the ball is dropped and the weight of the ball dropped on a molded part, repeated shock can be applied to the test specimen at a range of points up to its actual breaking point.

Results of the "drop ball" test, which are calculated in foot-pounds of energy to crack or



Just fifty-nine days after the National Supply Co. purchased assets of the engine division of the Atlas Imperial Engine Co., Oakland, Calif., this Atlas engine was ready for shipment from National's Engine Division at Springfield, Ohio. In this short time, the company shipped patterns and tools more than 2000 miles, made castings, did all machining, assembling, and testing, and dismantled the engine for shipment to the Philippine Islands, where it will be put to work at the Narvacan Power Plant. The engine, one of three identical naturally aspirated Diesels bought for the Philippine station, is a six-cylinder model which develops 350 H.P.

break the specimen, show that the newly developed rubber-phenolic compounds have shock resistance five to ten times as great as equivalent conventional phenolic molding powders.

Electric Motor Bearings Protected at Temperatures of 1500 Degrees F.

Electric motors are sometimes required to operate in very hot locations. For example, one 15-H.P. motor is mounted vertically beneath a steel annealing furnace to drive a blower that circulates the hot heat-treating gases. The blower handles gases that have a temperature of 1500 degrees F. The bearing of the motor, which must not be allowed to become overheated, is located only 14 inches from the blower.

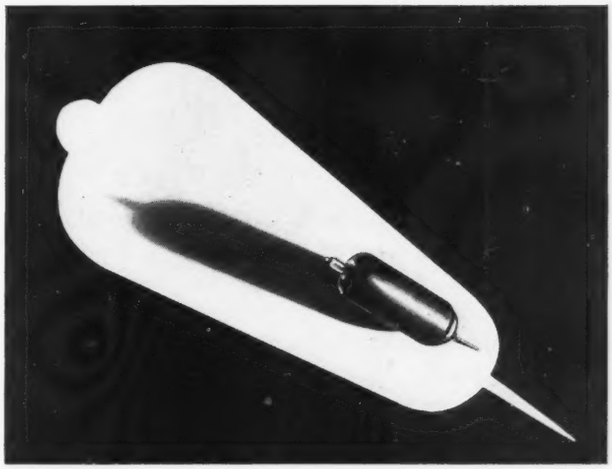
Protection against overheating was achieved by the Westinghouse Electric Corporation by the use of a prelubricated sealed ball bearing, mounted on a shaft of chromium-nickel steel, which has low thermal conductivity, and a heat exchanger to remove heat from the shaft. The exchanger lowered the temperature at an effective rate of 100 degrees F. per inch, resulting in a bearing that runs acceptably cool.

Timing Equipment Records Velocities up to 2000 Miles Per Hour

The velocity and acceleration of objects moving at 2000 miles an hour and faster can be recorded and measured in a single optical image by a new Beckman & Whitley temporal sequence system based on slit type camera techniques.

To measure the speed of moving objects or operations in process, a slit camera records the time sequence past, or within, a vertical plane passing through the optical axis of the lens. Besides photographing the operation, this equipment automatically records, on the same film, electronically timed numbers showing elapsed seconds and hundredths of seconds, with intermediate graduations spaced at thousandths of seconds. The accuracy of these markings is within 0.002 of 1 per cent. Continuously variable film speed in either direction permits the recording of movements progressing in either direction. Used in this way, the camera produces a strip picture looking like a conventional stop-action photograph of two-dimensional space.

In addition to measuring the velocity and acceleration of high-speed objects such as missiles, projectiles, etc., the instrument is useful for recording oscillograph traces and other oscillations taking place vertically within the slit plane, as, for example, the movement of machine parts.



Geiger counter tube with outside coating of colloidal graphite

New External Coating for Geiger Counter Tubes

A mixture of hydrolized ethyl silicate and colloidal graphite dispersion is now being used as a coating on the outside of Geiger counter tubes by the Raytheon Mfg. Co., Newton, Mass. This colloidal graphite coating, known as "dag" dispersion No. 154, is manufactured by the Acheson Colloids Corporation, Port Huron, Mich. It was selected for the tube shown in the illustration because it is chemically inert, electrically conductive, opaque, and adheres tenaciously to any glass surface despite scratches.

The unusual feature about this use of "dag" dispersion 154 is that it is applied to produce a durable coating on the outside of the tube. This coating on the tube serves as the collector of ion current, a function generally performed by conducting cathodes inside the tube.

Sheet Steel Trimmed at Rate of Thirty-Four Miles an Hour

Sheet steel is trimmed at the rate of thirty-four miles an hour in a high-speed side-trimming line designed by the Westinghouse Electric Corporation. The line trims off rough or damaged edges and holds the variation of the coil edges to 1/32 inch, preparatory to tinning.

Rated operating speed of the line is 3000 feet per minute, but in test runs, a speed of 3600 feet per minute, or 40 miles per hour, has been attained. This is accomplished by means of photoelectric edge regulators and suitable control of the trimmer motors. The control meets the further requirement of maintaining the speed of the cutter at any preselected amount faster than the rate of travel of the strip for all speeds.

Inexpensive Blanking Punch and Die

By P. D'AGOSTINE

A METHOD that makes it possible to produce blanks on a standard punch press at a relatively low initial die cost has been developed by the Switchgear Divisions of the Apparatus Department of the General Electric Co. The holder shown in Figs. 1 and 2 was designed to accommodate a thin punch and die 1/4 inch or less in thickness. Actually, the punch and die members required for each irregular contour of the blank to be produced are simply male and female templets made from commercial ground oil- or water-hardening tool steel, as shown in Fig. 3.

The die templet is first laid out and then sawed and filed to the desired size. No die relief is required, since these dies operate on the same principle as the conventional compound die, the blank being returned to the top of the die. The die is then hardened, after which the punch is made and provided with suitable clearance, depending upon the thickness and type of material to be punched.

This punch and die holder is designed to accommodate a range of blank sizes within an area of 4 by 6 inches and up to 1/8 inch thick. Blanks from brass, copper, mild steel, stainless steel, paper, and various compounds have been successfully produced with this set-up. The punching area of 4 by 6 inches was arbitrarily selected because it fills most of the requirements in this shop. A proportionately larger holder can be used for larger blanks. Although this set-up was originally developed for low quantity production, under certain conditions large quantities can also be produced economically with it.

Referring to Fig. 1, the holder consists of a precision die set, on the lower member *B* of which a large platen *A* with evenly spaced holes is mounted; and a removable punch plate *D* (mounted on the upper member), which is retained in position by two dovetailed clamps *E*.

The die templet *F* is held to platen *A* by means of four quick-acting cam-locks *G*, and is retained by a cam lock support *H*. The required number of ejection pins *J* are set in the holes within the area of the die opening. An air cushion *K*, acting on the pins *L* and *J*, eject the blanked part.

The punch *M* is fastened to the punch plate *D*

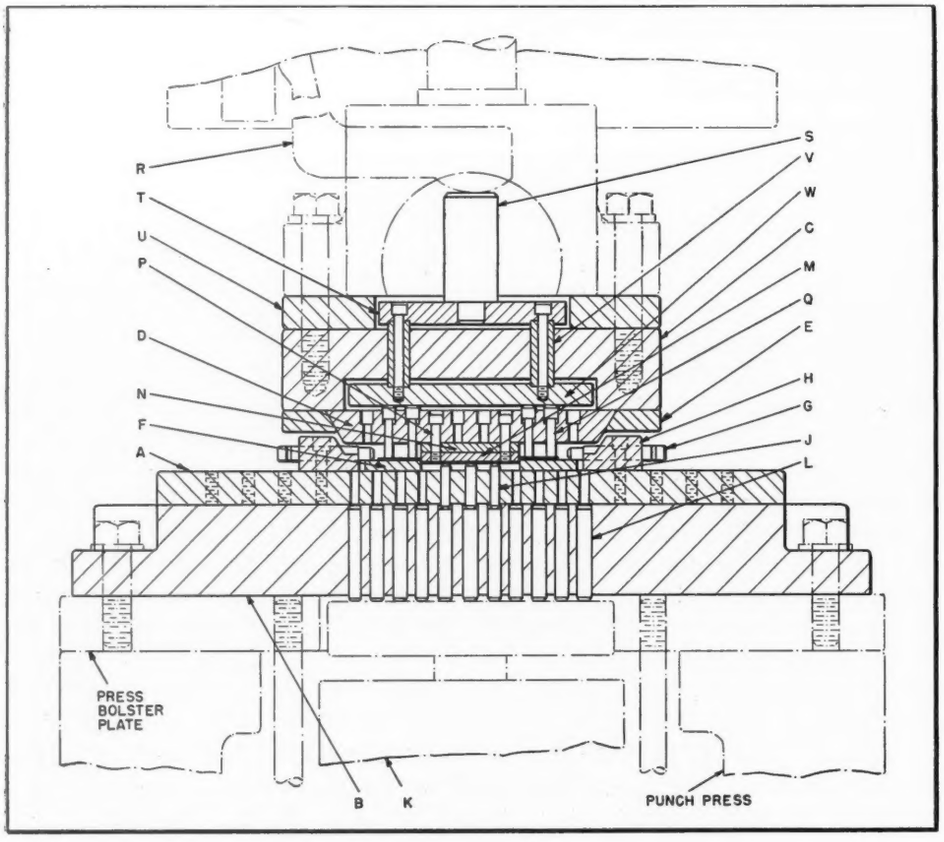


Fig. 1. Cross-section of assembled punch and die holder and punch and die templets for producing small quantities of irregular-shaped parts

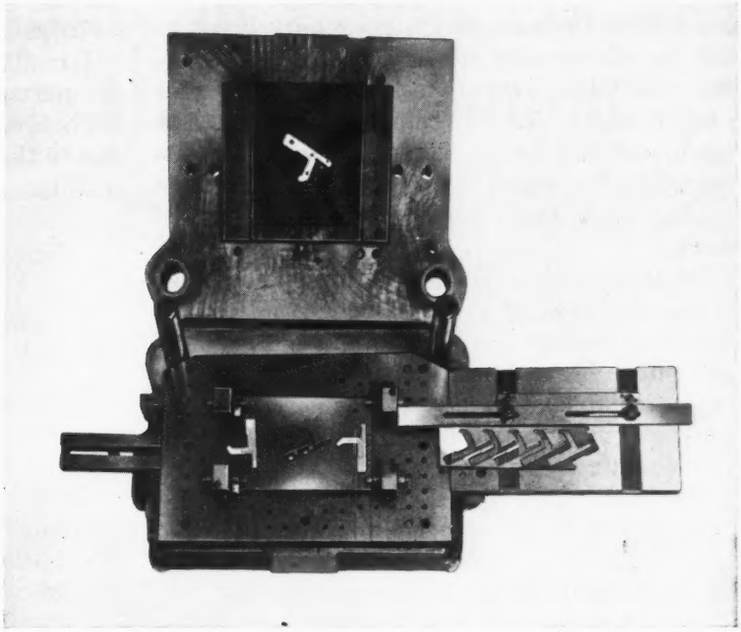


Fig. 2. General view of die holder illustrated in Fig. 1, showing punch and die templets and blanked parts lying on the die platen

with a 1/4 inch thick spacer *N*, using at least two screws *P*. The shoulder pins *Q* in the punch plate, passing through holes adjacent to punch *M*, eject the scrap on the return stroke of the ram. This is effected by the positive knock-out *R* of the press coming in contact with part *S*. Other parts of the unit consist of knock-out ring *T*, spacer plate *U*, spacer bushings *V*, and knock-out plate *W*.

The holder is permanently mounted in a punch press and properly guarded to prevent the operator from reaching into the danger zone. The press is equipped with a non-repeating tripping device as an added protection for the operator.

The method of setting up punch and die templets in the holder is illustrated in Fig. 4. This work begins with the bench operations, which include fastening the punch *M* and spacer *N* to the punch plate *D* on predetermined centering lines. This is followed by placing a suitable thickness of gauze on the punch, depending on the thickness of the material to be cut. The die *F* is then placed over the punch so that the gauze lies between the punch and die, thus insuring accurate centering of these two members. After this, permanent magnets are placed between the punch plate and the die templet to hold the die temporarily in its correct position.

The assembled unit is now transferred to the punch press and slid between the two dovetailed

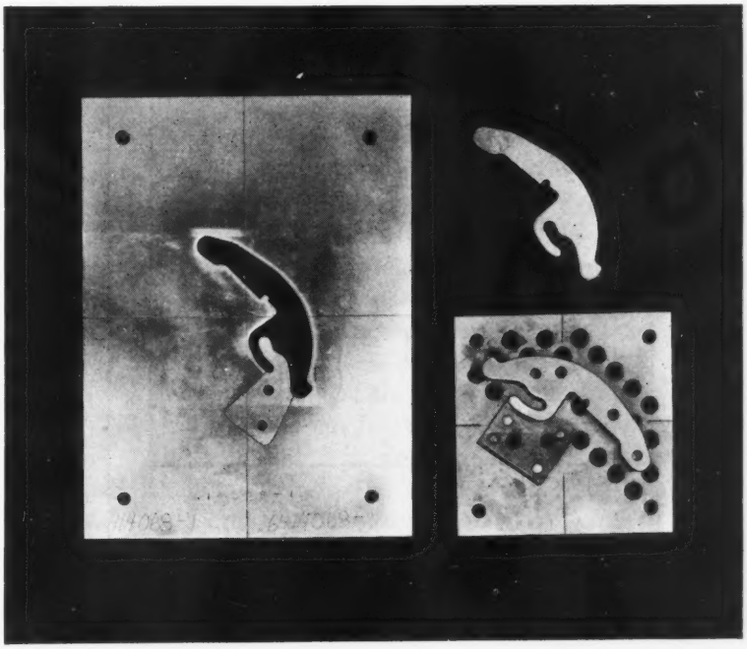


Fig. 3. Punch and die templets, made from commercial ground oil- or water-hardening tool steel, used in holders of the type illustrated in Figs. 1 and 2

clamps *E*, Fig. 1, which are tightened in position. Then the ram of the press is lowered so that the die templet contacts the die platen *A*, after which the parts are locked in place by cams *G* and retainers *H*. The ram of the press is now raised and the gauze and permanent magnets removed, after which the stock guide is adjusted and the die is ready for operation in the usual manner.

The strip stock is fed from left to right, guided on one side against a pre-positioned adjustable gage, such as shown in Fig. 2. Spacing for blanking is done by sight until the strip reaches the end adjustable stop, after which the blanked opening is used for spacing. Blanks are ejected from the die by an air jet on the return stroke of the ram. The specially designed knock-out arrangement described permits the stripping of the stock off the punch, about 1/4 inch from the die, after the blank has been disposed of.

A great number of these inexpensive punches and dies have been made and are in operation, producing flat, uniform blanks that are free from burrs. With this set-up, it is possible for the tooling and the production of this type of work to be performed in a short period of time.

Irregularly shaped contours with sections that are normally considered weak in a conventional die hold up beyond all expectations in this set-up, due to the rigid punch and die support, and tool maintenance costs are practically nil.

* * *

Single-Point Tools and Involute Spline Standards

Two new standards in the series of standards for small tools and machine tool elements have recently been approved by the American Standards Association. One, ASA B5.22-1950, covers single-point tools and toolposts. The other, ASA B5.15-1950, relates to involute splines. Copies of these standards can be obtained from the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y. The price of the single-point tools and toolposts standard is $1.25, and of the involute splines standard $2.

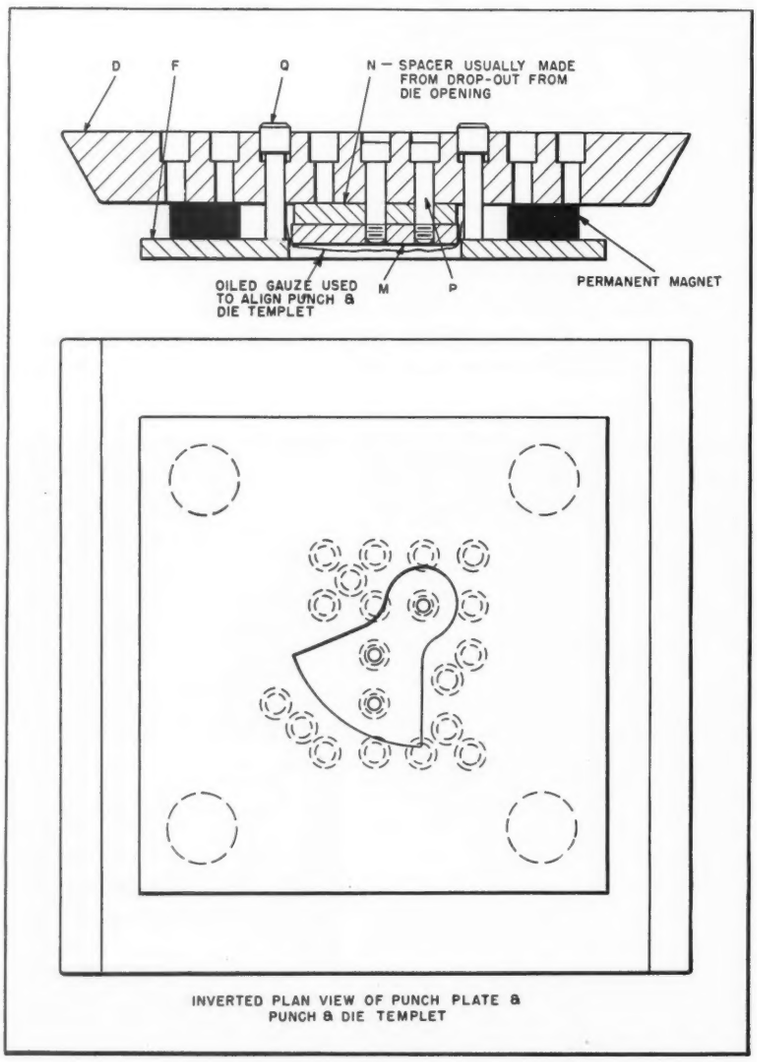

D
F
Q
N — SPACER USUALLY MADE FROM DROP-OUT FROM DIE OPENING
OILED GAUZE USED TO ALIGN PUNCH & DIE TEMPLET
M
P
PERMANENT MAGNET
INVERTED PLAN VIEW OF PUNCH PLATE & PUNCH & DIE TEMPLET

Fig. 4. Setting up a punch and die templet is accomplished in three bench operations, followed by locating, aligning, and clamping the tools in the press

Civic Responsibility of Engineers the Theme of A.S.M.E. Convention

MORE than 200 papers were heard by approximately 7500 engineers at the seventy-first annual convention of the American Society of Mechanical Engineers, which was held at the Hotel Statler November 27 to December 1. The theme of the meeting, "The Engineer and His Civic Responsibility," was sounded by A. W. Robertson, chairman of the board of the Westinghouse Electric Corporation, in the keynote address at the president's luncheon on the first day. Mr. Robertson's remarks were directed to student and junior members, as well as to older members of the Society whose faith in the American way of life may be intuitive and who need to have at their fingertips the facts and philosophy to defend and promote it.

J. Calvin Brown, president of the American Society of Mechanical Engineers for the year 1951

Distinguished American engineers, scientists, and inventors were honored at the annual dinner, on November 29, at which Howard C. Coonley, chief conservation planning specialist for the National Security Resources Board, was the speaker. He revealed that the N.S.R.B. will recreate a Conservation Coordinating Committee such as operated during the last war as part of an all-out drive for conservation in the field of mobilization planning. The committee will include representation from all three divisions of the Department of Defense, the Munitions Board, the National Production Authority, and other government departments and agencies that have a major concern with materials, facilities, manpower, and production. The role of the committee will be to initiate and develop broad unified programs of conservation in the mobilization effort.

The highest award of the Society—the A.S.M.E. Medal—was presented to Harvey C. Knowles, vice-president of the Proctor & Gamble Defense Corporation. This medal, conferred annually for distinguished service in engineering and science, was awarded to Mr. Knowles for contributions to the process industries and to the loading of ammunition.

At a management session, Harry Anderson, vice-president of General Motors Corporation, spoke on the significance of the General Motors' and United Automobile Workers' five-year contract. James D. Mooney, chairman of Technical Managers, Inc., in an address at this session, urged small businessmen to establish plants in foreign countries. While admitting that most American capitalists, because of the national exchange problem, were not enthusiastic about making new investments abroad or expenditures for improvement of properties in overseas countries, Mr. Mooney stated that many companies have found it possible to obtain returns from their business abroad in currencies or commodities by means of which, through barter, arbitration, or multiple currency exchanges, they are able to salvage a good portion of their net returns. A number of companies specializing in just such transactions, he said, have sprung up since the end of the war, and because of managed currency, blocked currencies, and the dollar gap, an amazing amount of barter trade has taken place, particularly in Europe.

During a luncheon address, Don G. Mitchell, president of Sylvania Electric Products, Inc., pointed out that small plants and businesses have multiple advantages over large companies from the standpoint of labor and community relations, as well as in certain aspects of management. Mr. Mitchel's remarks were based on the operation of the Sylvania corporation, which he described as a large "small company" operating under a policy of decentralization of manufacturing, wherein the line authority is out in the field and the functional authority stays at headquarters.

Other prominent speakers at luncheon and dinner sessions were W. R. Woolrich, dean of

engineering, University of Texas, who discussed the industrial economy of Great Britain, and James Boyd, director of the Bureau of Mines, Washington, D. C.

Many papers of particular interest to the metal-working industry were presented at the technical sessions. Among these was one entitled "Some Industrial Experiences with Synthetic Lubricants," which was prepared jointly by C. H. Sweatt, research engineer, and T. W. Langer, research chemist of the Union Carbide and Carbon Corporation. It was pointed out that substantial savings in production costs and improved operation of mechanical equipment are possible through the substitution of synthetic lubricants for petroleum products in certain industrial applications. This is especially true when unusual or severe operation conditions exist.

Under the auspices of the Production Engineering Division, with Charles L. Tutt, Jr., assistant to the president, General Motors Institute, presiding as chairman, a paper entitled "Producing 65,000 Pistons per Day Using Automation with Quality Control" was read by W. R. Slattery, section supervisor, Plant Lay-out Production Office, Ford Motor Co. This paper explained the utilization of automation and quality control in production processes generally, and as an example, the production of automotive pistons was described to show how automation reduces handling costs.

Another paper of interest to the metal-working industry was "Factors Affecting Production on Single Automatic Screw Machines," by W. E. Rollins, engineer, Screw Machine Department, Brown & Sharpe Mfg. Co. In this paper, Mr. Rollins showed that maximum production from single-spindle automatic screw machines depends on performing as many operations as possible at the same time, together with the use of the highest speeds and feeds compatible with tolerance and finish requirements and tool economy. By the use of attachments, with machines of this type, productivity is increased and subsequent operations on the work are reduced.

Myron S. Curtis, director of engineering, Warner & Swasey Co., contributed a paper entitled "Application of Automatics to Small Lot Production." Mr. Curtis called attention to the fact that, in both automatic multiple- and single-spindle machines, a point is reached, as the number of pieces in a lot grows smaller, where it is no longer economical to use an automatic machine.

Under the auspices of Research Committees on Metal Cutting Data and Cutting Fluids, as well as the Production Engineering Division, two papers of especial interest were presented, with Orlan W. Boston, chairman, Department of Metal Processing, University of Michigan, presiding. One of these papers, entitled "Basic Factors in the Hot Machining of Metals," was contributed by E. J. Krabacher, research engineer, and M. E. Merchant, senior research physicist, Cincinnati Milling Machine Co. This paper described the results of research on the influence of basic metal-cutting qualities when machining metals at elevated temperatures.

The other paper offered at this session was "Cutting Temperatures and Metal Cutting Phenomena," by B. T. Chao, research associate, Department of Mechanical Engineering and K. J. Trigger, professor of mechanical engineering, University of Illinois. Important findings resulting from investigations on the mechanism of heat generation during metal-cutting operations were given in this paper. It has been found that many changes during the cutting of metals are due to the change in tool-chip interface temperature through its influence on tool-chip friction.

Other outstanding papers included "Grinding Fluids—Characteristics and Applications," by H. W. Wagner, research engineer, Research Laboratories, Mechanical Section, Norton Co.; "The Application of Cutting Fluids to Machining Operations," by E. H. Streider, assistant sales manager, Cincinnati Milling Products Division, and R. B. Niebusch, manager shop tools, Cincinnati Milling Machine Co.; "Some Design Aspects of Metal Powder Parts," by D. C. Bradley, Metal Division New Jersey Zinc Co.; "The Fields of Application of Investment Casting," by Rawson L. Wood, president, and D. Von Ludwig, Arwood Precision Casting Corporation; and "The Maintenance and Servicing of Hydraulic Systems for Machine Tools," by J. Howard Groom, field service department manager, Cincinnati Milling Machine Co.

James Dalton Cunningham, president of Republic Flow Meters Co., the outgoing president of the American Society of Mechanical Engineers, introduced the president for 1951, J. Calvin Brown, engineer and patent attorney, of Los Angeles, Calif., at the annual dinner. Mr. Brown became a member of the Society in 1928. He served as manager in 1943-44 and as vice-president from 1945 to 1949. Mr. Brown has been active in the affairs of the Southern California Section of the Society.

* * *

Bauxite, the ore from which aluminum is extracted, was first found in the United States in 1883, near Rome, Ga.

Tool Engineering Ideas

Tools and Fixtures of Unusual Design, and Time- and Labor-Saving Methods that Have been Found Useful by Men Engaged in Tool Design and Shop Work

Attachment for Automatically Loading Buttons in Screw Machine

By CARL W. JOHNSON, Cranston, R. I.

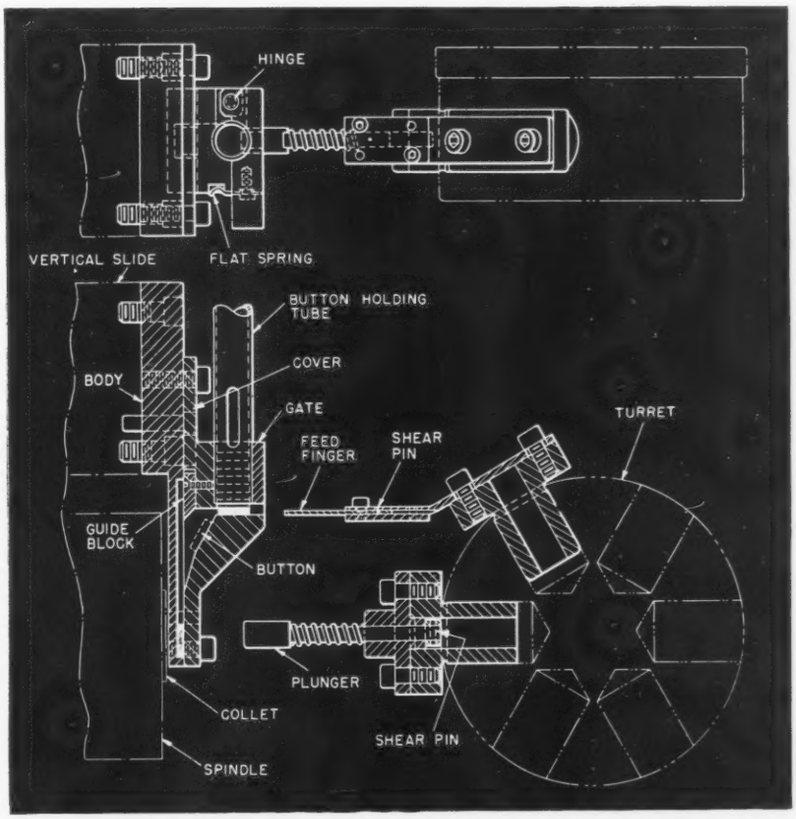
Small brass buttons are automatically loaded into the collet of a Brown & Sharpe screw machine for a beveling operation by means of the attachment shown in the illustration. The brass buttons, 1/2 inch in diameter by 0.093 inch thick, are blanked and dented on one face in a punch press. The indentation is used as a locating point when machining the bevel.

The attachment consists essentially of a body, cover, gate, and button-holding tube, which are carried on the vertical slide of the machine, and a feed-finger and loading plunger which are held on the turret. The body of the attachment is fitted and bolted to the vertical slide of the screw machine, and its lower portion is slotted to provide a vertical passageway for the buttons. The cover, screwed to the body, is machined to permit the buttons to slide into the passageway in the body. A guide block, which is screwed into a recess on the inner face of the cover, directs the buttons downward into this passageway.

The cover of the attachment is provided with a hinged gate that clamps the tube, loaded with buttons, in position. A flat spring snaps into a slot in the cover to hold the tube in position during operation. Several tubes are employed, so that some may be loaded with buttons, dented face up, while one is in use on the machine.

The feed-finger and spring-loaded plunger are mounted in holders at adjacent stations on the machine turret. When the vertical slide descends and the turret is advanced, the feed-finger pushes the lowest button from beneath the tube. The button falls through the cover and into the slot in the body. The spring-loaded plunger, passing through the holes drilled in both the cover and body, pushes a button that has been previously fed into the slot into the open collet of the machine, seating the dent in the button against a stop-pin in the collet. The collet then closes, the turret is retracted, the vertical slide is raised, and a form tool on the rear cross-slide advances to bevel the work.

When the cut has been completed, the tool retracted, and the work ejected, the cycle is repeated. Shear pins are provided for both the feed-finger and plunger, so that, if jamming occurs, the attachment will become inoperative. A clearance of from 0.005 to 0.010 inch is provided between the back face of the attachment and the outer face of the work when it is loaded.



Round, flat buttons are automatically fed from below a holding tube and pushed into an open collet by means of this screw machine attachment

Milling Fixture for Rounding Corners of Square Shafts

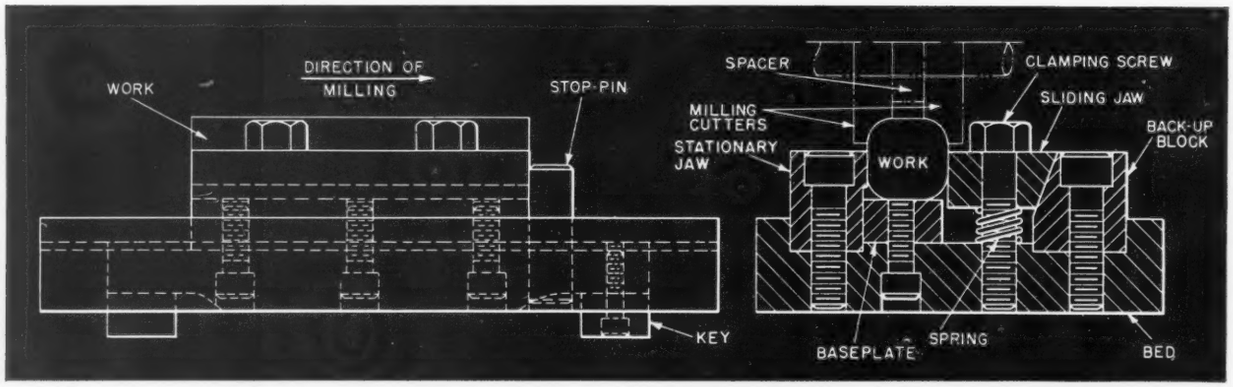
By IRVING MANSFIELD

A fixture designed for positive clamping of a square shaft while milling rounded corners on the shaft is shown in the accompanying illustration. The shafts, made from S A E 1020 cold-rolled steel and used in the manufacture of farm equipment, measure only 1 3/16 inches square and 5 inches long. All four corners, for the full length of the part, must be milled accurately to a radius of 3/8 inch.

The work rests on a hardened and ground baseplate and against a stationary jaw. A stop-pin, made from a standard dowel 5/8 inch in diameter, locates the work lengthwise. One side of the back-up block is machined at an angle to fit the mating face of the sliding jaw. Two compression springs are placed under the sliding jaw so that the jaw will be lifted out of contact with the work when the clamping screws are loosened. This permits easy unloading and reloading of the fixture.

Two keys are bolted to the bottom of the fixture for locating it on the milling machine table. Both the stationary jaw and the back-up block are sunken into the fixture bed to provide greater rigidity for resisting clamping pressure.

After milling two corners, the position of the work is reversed to finish the corners on the opposite side. Special milling cutters, ground with the desired radii, are separated by a hardened and ground spacer on the milling machine arbor.



Fixture designed for positive clamping of small square shafts while milling accurate round corners

Welded Indexing Jig for Drilling a Casting of Complicated Shape

By ROBERT MAWSON, Providence, R. I.

The cast-iron gear-box shown in Fig. 1 requires the drilling of eight 0.191-inch diameter holes. Before drilling these holes with the jig shown in Fig. 2, several surfaces were machined, certain holes were bored, and other holes were drilled and tapped. As the eight holes to be drilled were so closely spaced, a jig in which the work is held stationary while the jig is indexed would present difficulties in design. To solve this problem, a jig was designed in which the work is moved to the several drilling positions by a swinging arm, which indexes the part as needed.

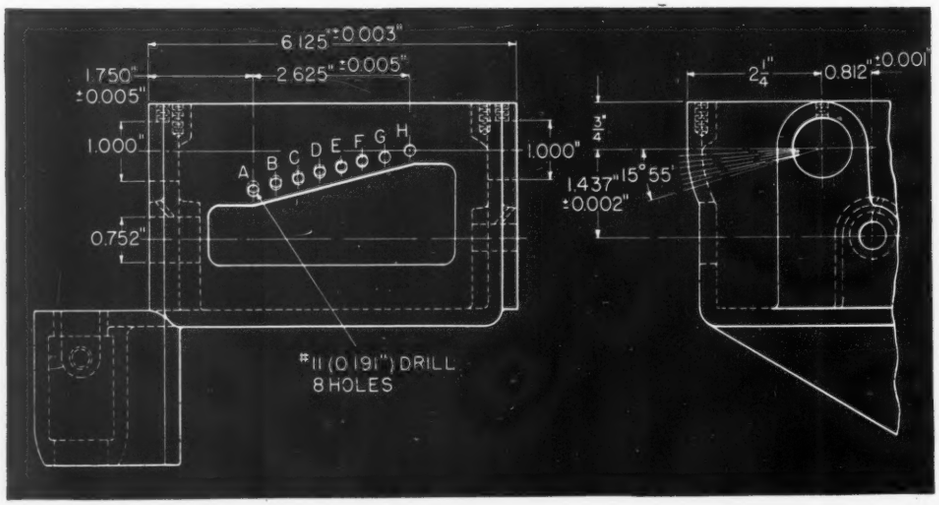


Fig. 1. Cast-iron quick-change gear-box in which eight small holes were accurately drilled by indexing the work in the jig shown in Fig. 2

Steel shapes were cut to the proper lengths and welded together to form the body of the jig. Several faces were then machined to obtain locating surfaces. This welded construction provides a light but strong and rigid jig.

The upper surface of the two outside plates is recessed as at *A*, Fig. 2, and to the recessed portion is attached a hardened tool-steel drill guide plate *B*, in which eight holes are drilled and eight guide letters stamped. After hardening plate *B*, the holes are lapped to accommodate a 0.191-inch diameter drill. A swinging arm *C* is attached to the jig body by means of a threaded and shouldered stud *D*. This stud has a work-locating portion which is a running fit in a 1.000-inch diameter hole in the work-piece. Accurately located in arm *C* is a second locating pin *E* with a shouldered part that is a sliding fit in a 0.752-inch diameter hole in the work-piece.

In the outer end of the arm is a knurled tool-steel locating pin *F*, and on the inside of the arm is attached a steel block *G*, which acts as a counterbalance when indexing the work-piece. A hardened tool-steel index-plate *H* has lapped holes which are engaged by indexing pin *F*. Guide letters *A* to *H* are stamped at each hole to correspond with those on plate *B*. It will be noticed that a notch has been machined at the end of arm *C* to permit the operator to see the guide letters when the work-piece is indexed to the different drilling stations.

In a boss welded on the jig body is a shouldered and threaded knurled-head locating pin *J* in line with pin *D*. The inner end of pin *J* is a running fit in another 1.000-inch diameter hole in the work-piece. The construction is such that when complete threaded engagement is made, the work-piece can rotate freely between the face of arm *C* and the shoulder on pin *J*.

In operation, a work-piece is put in the jig and located by the pins *D* and *E*. The pin *J* is next screwed into position, with the locating portion on the pin fitting the 1.000-inch diameter hole in the work-piece, until the inside face of the knurled end contacts the face of the jig boss. The work-piece is now accurately located and held, but is also free to rotate to the several drilling positions.

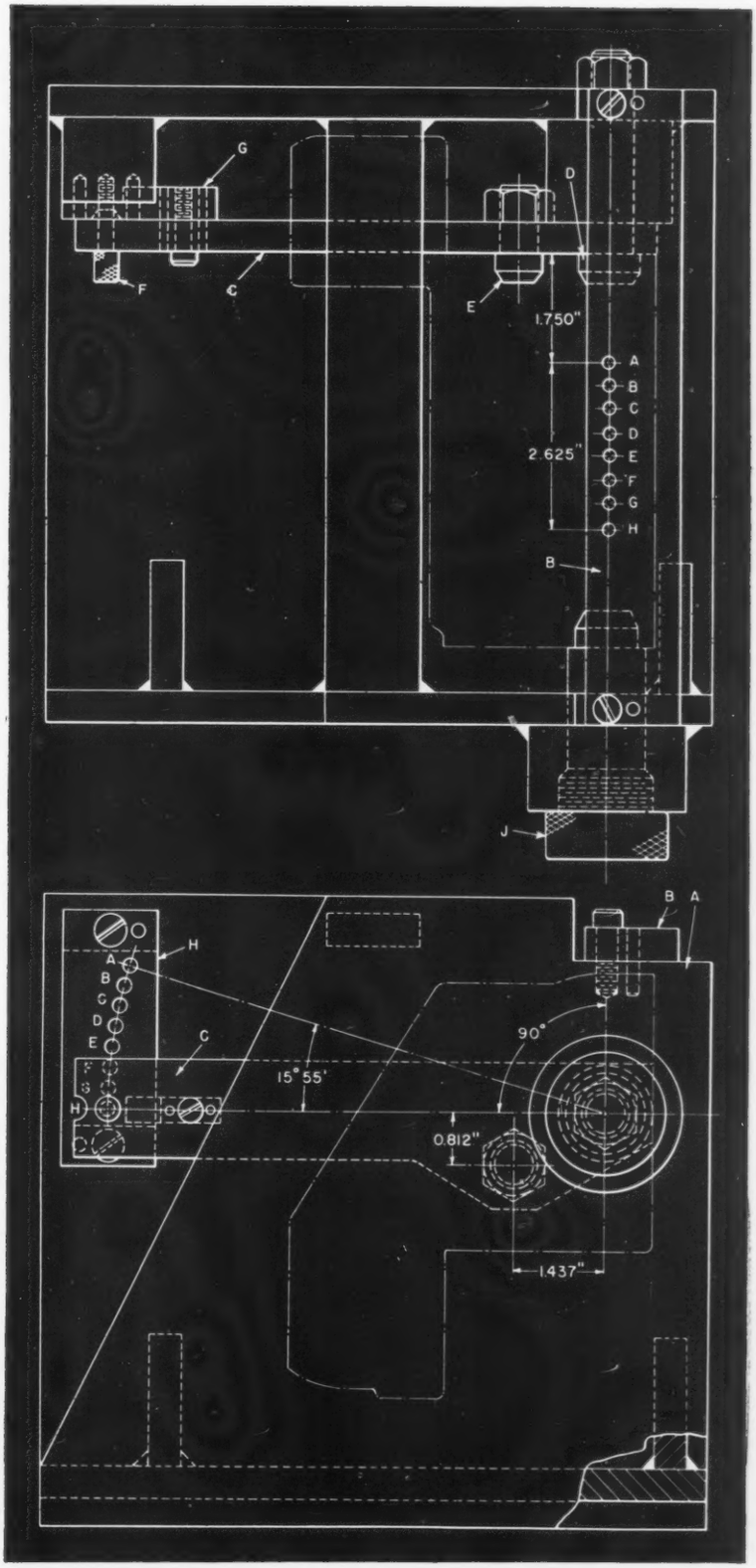


Fig. 2. The welded construction of this indexing jig provides a light but strong and rigid support for accurately drilling eight small holes in a cast-iron gear-box of complicated shape

The swinging arm, carrying the work-piece, is moved until the knurled pin *F* enters one of the holes—for example, *H*—in the index-plate *H*. A hole is then drilled in the work-piece, the drill being guided through hole *H* in plate *B*. The indexing of the work and arm *C* is repeated until the eight holes have been drilled.

To remove the completely drilled work-piece, it is only necessary to unscrew pin *J* and disengage the work from the locating pins *D* and *E*.

Chucks for Holding Work-Pieces by Threaded Portions

By ROBERT W. NEWTON, Assistant Chief Tool Designer
New York Air Brake Co., Watertown, N. Y.

It is sometimes desirable to chuck a work-piece on a threaded portion of the part. If such a work-piece has a hexagonal or some other flat-sided surface, it can easily be unscrewed with a wrench at the conclusion of the operation. A wrench is generally necessary to break the seal formed between the work and the chuck face by the pressure of the cutting tools. If the part to be machined is round, with no flat surfaces, or if the surfaces of the work-piece should not be marked or damaged, the chuck must be designed so that this seal can be broken without using a wrench.

The chuck illustrated in Fig. 1 is used for holding a symmetrical-shaped piston by means of an internal thread while machining the opposite end of the part. The chuck seen in Fig. 2 is employed for holding a bushing by means of an external thread while finish-boring the work. An entirely different approach is necessary in designing chucks to hold work-pieces by external threads than that required for chucking on internal threads.

The male chuck, Fig. 1, consists of a body which is internally threaded to fit the spindle nose of a screw machine. A stud is threaded on one end to fit the work-piece, and has a left-hand thread on the opposite end to fit a plate. The stud is a slip fit in a hardened bushing, which is pressed into the chuck body, and is also keyed to the body by means of a pin which slides in a keyway in the body.

For additional accuracy in locating the work, a hardened cover, which is screwed and doweled to the chuck body, is machined to fit the bead on the face of the piston. A handle, screwed into the plate, can be moved through an angle of 60 degrees in a clearance slot provided for it in the chuck body. The handle is pushed against one side of the clearance slot before a piece is screwed on the chuck. After the machining operation is finished, the handle is moved to the opposite side of the slot. This rotates the plate on the stud, thereby breaking the seal between the piston and the cover. A hole drilled radially in the periphery of the chuck body provides a means for mounting the chuck and removing it from the spindle nose of the machine with a spanner wrench.

The female chuck, Fig. 2, consists of a body which is threaded to fit a master chuck adapter. A nut, screwed on the chuck body, is internally threaded to fit the work. The outside of the nut is slotted to permit using a spanner wrench. The loose plug is made a slip fit in the nut, and rests against the face of the body. A recess is provided in the center of the plug to clear the boring tool.

In chucking, the work is screwed against this plug. After the work-piece has been machined, a slight turn of the nut will break the seal formed between the work and the plug. Flats are provided on the chuck body for mounting and removing the chuck from the adapter.

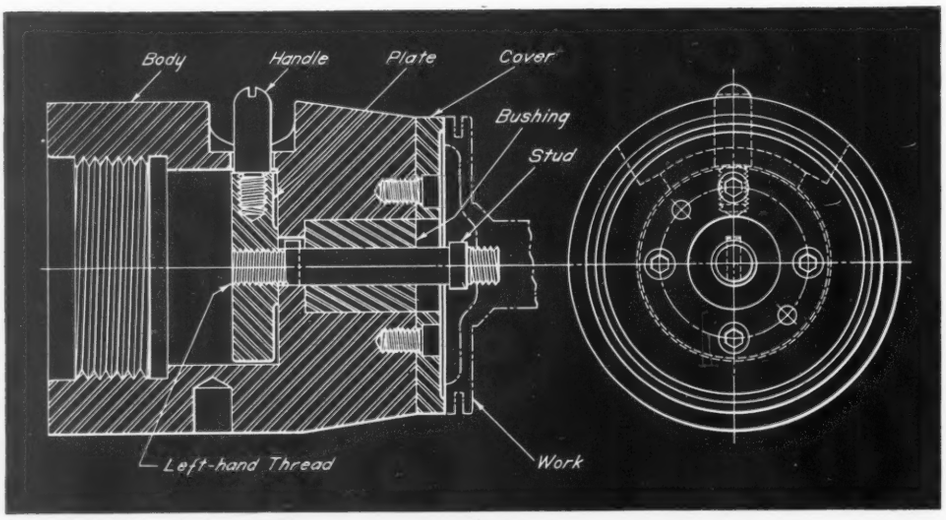


Fig. 1. Seal formed between the work and cover by the pressure of the cutting tools is broken by moving the handle on this special chuck

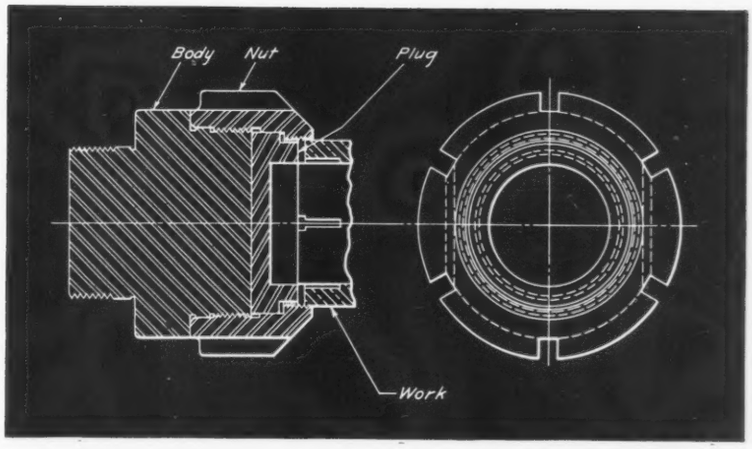


Fig. 2. When the work-piece has been bored, the nut is rotated slightly to break the seal between the work and chuck face produced by the cutting pressure

As can be readily seen, these chucks can be designed to fit a large variety of work-pieces and can be used on many different types of machines. They are economical to make, and yet provide a quick and accurate way to hold work during machining.

* * *

"The Shortest Way" — A Movie on Die-Casting

A motion picture described as "graphic evidence of the coming of age of the die-casting process" was recently released by the Doehler-Jarvis Corporation, New York City. It was pointed out that the release of this film coincides with the beginning of a national emergency, in which the die-casting industry is prepared to once more play a vital role. In this connection, it is of interest to note that, in World War II, the Doehler-Jarvis Corporation produced more than 9300 different parts for military equipment.

"The Shortest Way" emphasizes the fact that die-casting is a mass production process. The film runs for twenty-seven minutes, and was produced in the seven Doehler-Jarvis plants by the Jam Handy Organization. H. H. Doehler, chairman of the board, in discussing the film, expressed the belief that the die-casting industry is still in its infancy, even though approximately $250,000,000 worth of business in done annually by job shop die-casters of this country alone. He predicted that within the next ten years the figure, on a world-wide basis, would reach close to a billion dollars.

The title for the film was based on a slogan adopted years ago by Mr. Doehler: "From raw material to finished product in a matter of seconds—that is die-casting." The film is intended for showings by technical societies, users and prospective users of die-casting, product engineers, technical students, and other groups interested in modern manufacturing processes. Requests for use of the film should be addressed to the Department of Public Relations, Doehler-Jarvis Corporation, 386 Fourth Ave., New York 16, N. Y., or to any of the company's plants.

* * *

The Machine Tool Industry's Plans for a National Emergency

Plans for the activities of the machine tool industry in the event of an all-out emergency have been completed and are in the hands of the National Production Authority, ready for instant use, according to Herbert L. Tigges, president of the American Society of Tool Engineers and vice-president of Baker Brothers, Inc.

The industry, according to Mr. Tigges, has determined its capacities for production, arranged in advance for financing to step up output, and planned for the most effective distribution of its efforts. The plans also include allocation of the industry's output by percentages, the reassignment of idle machine tools, and the effective distribution of used machines now in the hands of dealers.

* * *

New Film on Aircomatic Welding

"The Tool for the Job," a new motion picture produced by the Air Reduction Sales Co., Division of Air Reduction Co., Inc., explains the nature, character, and uses of the Aircomatic welding process. One of its outstanding features is the close-up photography of the Aircomatic arc.

Covered in some detail by demonstration and laboratory sequences, as well as by production examples, are the manual and automatic welding of such metals as aluminum, stainless steel, bronze, and Monel. Arrangements for showing the film may be made by sending requests to the Air Reduction Sales Co., 60 E. 42nd St., New York 17, N. Y.

Materials of Industry

THE PROPERTIES AND NEW APPLICATIONS OF MATERIALS USED IN THE MECHANICAL INDUSTRIES

Improved Cutting Oils Increase Life of Cutting Tools

Field tests made with improved Gulf Lasupar cutting oils recently announced by the Gulf Oil Corporation, Pittsburgh, Pa., showed substantially increased life of cutting tools. These oils have a light color, good transparency, and anti-rust properties, while retaining all the performance characteristics of the former grades. Excellent anti-weld properties and load-carrying ability are obtained in these oils by the inclusion of free elementary sulphur, sulphurized mineral oil, and sulphurized fatty oil. 1

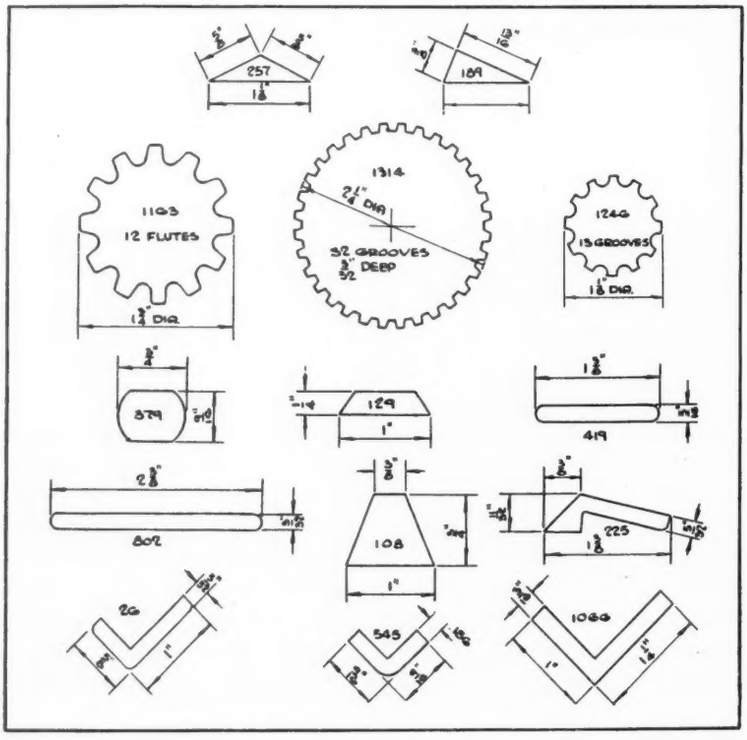
Precipitation-Hardening Hot-Working Steel for Forging Dies

A hot-working steel known as "Prestem," which is available in the form of solid press dies, insert dies, upsetter dies, and punches is being marketed by Heppenstall Co., Pittsburgh, Pa. The new steel is said to be useful either as solid or insert dies for those drop-forging plants that make pressed and upset forgings for the automotive, aviation, and farm implement industries.

Characteristics of this steel include ready machinability at comparatively high hardness, good impact resistance, and a minimum amount of heat checking. The material is available in three hardness ranges—41 to 45 Rockwell C; 36 to 40 Rockwell C; and 38 to 42 Rockwell C. The last grade is supplied in a prehardened, untempered condition, intended to be tempered by the customer after machining. 2

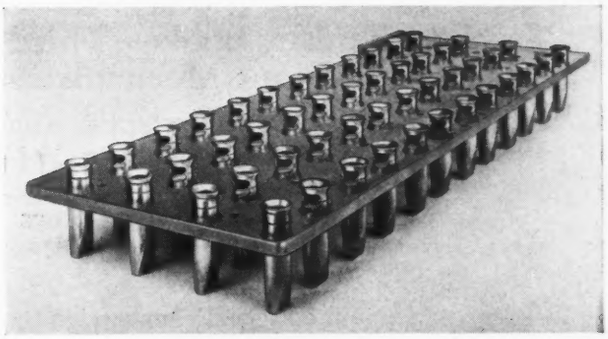
Stripper Removes Nickel and Other Metals from Copper-Base Alloys

Enthone, Inc., New Haven, Conn., has developed a new compound for rapidly stripping nickel, tin, lead, and chromium from copper,



Typical examples of steel bar stock cold-drawn in special sections to fit specific uses. Available from A. Milne & Co., of New York City

To obtain additional information about materials described here, use Inquiry Card on page 229.



Equipment made by Anderson Brothers Mfg. Co. to increase production of popsicle-type products. Designed to hold many popsicle pallets at a time, each unit contains forty-eight tubes of stainless steel. The special-temper bright-annealed stainless-steel Type 304 tubes, made by the Carpenter Steel Co., are 1/2 inch outside diameter by 0.021 inch thick, and are flared and punched at one end and swaged at the other

brass, and other copper alloys without attack on the base metal. The work to be stripped is immersed in an acid solution containing Metal Stripper N-165, and the removal of the metal is accomplished without the use of an electrical current.

The process is said to be especially adapted for the removal of nickel from bulk plated work, as well as from heavier plated objects, and is also suitable for the removal of nickel and chromium for the tips of plating racks. Stripping rates as high as 0.006 inch of nickel per hour have been obtained. The new compound is not suitable for the removal of nickel from steel or zinc-base alloys, Metal Stripper A being available for such applications. 3

Water Remover for Plated or Unplated Metal Parts

A compound called "Aqua-Off" has been developed by the Chemclean Products Corporation, New York City, to remove water from plated or unplated work. The work is immersed in the compound, gently agitated, and then removed. The water is displaced and falls to the bottom of the container, leaving the work free from water but covered with a slight film, which is readily removed by holding the part in the vapors of a degreaser. This procedure eliminates the use of sawdust or drying cabinets. 4

Coating That Provides High Wear Resistance to Aluminum

The development of a coating for aluminum that makes it twice as wear resistant as case-hardened steel has been announced by the Glenn L. Martin Aircraft Co., Baltimore, Md., according to *Ordnance*. The new coating, designated M.H.C., is applied by an electrochemical process. For average jobs it is spread on about 0.002 inch thick.

With the new finish, it is said that aluminum can now be used for many items that formerly required heavier metal, especially in aircraft. The company reports that coatings have been applied with success to such dissimilar things as gears and pinions, surveying instrument parts, hand tools, and leg braces for paraplegics.....5

Fast-Drying Plastic Finish for Metal Trim

A clear, fast-drying plastic synthetic finish known as Base VC-38, for use on metal trim and hardware, has been developed by the United Lacquer Mfg. Corporation, 1001 W. Elizabeth Ave., Linden, N. J. This finish can be applied to iron, copper, gold, cadmium, chromium, nickel, and brass, and can be tinted to give a gold or brass color to steel or aluminum.

It is useful for finishing such parts as door knobs, trunk locks, handles, etc. Durability and resistance to marring and tarnish are provided. Application may be by dipping or spraying. The plastic coating is available in either a satin or a flat finish. 6

Molding Compound that Produces Flexible Accurate Molds

"Flexicast" Compound is a synthetic resinous material developed for making molds that are flexible, yet accurate and permanent. This cold-pour semi-liquid requires no mixing. It is recommended for taking impressions of internal contours for inspection purposes. Because of the trueness of impressions, excellent results are said to be obtained when checking impressions of components for such faults as under-cutting of internal threads.

The compound can be set by placing it in a furnace heated to 175 degrees F. and allowing it to cure one-half hour for each 1/2 inch of thickness. "Flexicast" Compound is distributed by the Engineers Specialties Division, Buffalo, N. Y. 7

To obtain additional information about materials described here, use Inquiry Card on page 229.

A New Mechanism Book — Third Volume of Ingenious Mechanisms

INGENIOUS MECHANISMS FOR DESIGNERS AND INVENTORS (Volume 3). Edited by Holbrook L. Horton. 536 pages, 6 by 9 inches; 317 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York 13, N. Y. Price, $6.

This is a companion book to Volumes 1 and 2 of the work "Ingenious Mechanisms for Designers and Inventors," previously published. Each volume is a self-contained reference work, the combined set forming a comprehensive encyclopedia of mechanical movements. The use of Volume 3 in conjunction with Volumes 1 and 2 has been facilitated by grouping mechanisms of the same general types under comparable chapter headings. For example, Chapter 2 of Volume 3 contains descriptions of some twenty gear and cam mechanisms for producing intermittent motion that are all different from, but perform functions similar to, those described in Volumes 1 and 2 under a similar heading.

The eighteen chapters or sections in Volume 3 deal with the following subjects: Cam Applications and Special Cam Designs; Intermittent Motions from Gears and Cams; Intermittent Motions from Ratchet and Geneva Mechanisms; Overload, Tripping, and Stop Mechanisms; Locking, Clamping, and Locating Devices; Reversing Mechanisms of Special Design; Reciprocating Motions Derived from Cams, Gears, and Levers; Crank-Actuated Reciprocating Mechanisms; Variable-Stroke Reciprocating Mechanisms; Mechanisms which Provide Oscillating Motion; Mechanisms Providing Combined Rotary and Linear Motions; Speed-Changing Mechanisms; Speed-Regulating Mechanisms; Feed-Regulating, Shifting, and Stopping Mechanisms; Automatic Work-Feeding and Transfer Mechanisms; Feeding and Ejecting Mechanisms for Power Presses; and Miscellaneous Mechanisms.

Of special interest is the chapter on hoppers and hopper selector mechanisms for automatic machines. Numerous types of hopper designs are described, including the center-board type, tube and rotary types, barrel type, tray type, vibratory type, and an ingenious magnetic design. Among the selectors are a spring-actuated pin type, a circular-blade type, a magnetic type, a selector for flat, hooked parts, a cup selector, and selectors designed to reverse the position of parts.

The illustrations and descriptions in this book are confined to important elements or units that may be applied to various types of automatic machinery and other mechanical devices. This eliminates the necessity of reading through lengthy and irrelevant descriptive matter. The mechanisms described have been effectively used in industry to perform the functions under which they are classified. Machine designers faced with a particularly difficult mechanism design problem will find many adaptable ideas among the mechanisms described. Conversely, designers who have worked out a tentative solution to their mechanism problem may find a simpler, less expensive mechanism described which will perform the same function. The set of three volumes comprises a total of 1610 pages and 920 illustrations of different mechanisms.

* * *

Naval Industrial Engineering Organization

The Navy Department has announced that a development is now under way for the creation of an Industrial Engineering Division under the Admiral in charge of field activities. This Division has been assigned the mission of systematically exploring production operations at all Navy Yards with a view to placing at the disposal of shipyard commanders the latest information regarding manufacturing techniques that have proved profitable in private industry. It is realized that private industry can contribute toward raising the plane of productivity in Government establishments.

The present plan is to employ trade specialists who are highly trained in the most modern practices applicable to the various types of shops in Navy Yards. These men will head sub-sections having headquarters in the Navy Department. They will be required to make a study of production methods and a subsequent constructive action report. The purpose of this plan is to bring men and machines in naval establishments completely up to date, so that they can meet current work loads and will be prepared for any emergency that might arise from a hostile act on the part of a potential enemy.

The positions now being created in the Industrial Engineering Division are considered by top Navy management to be permanent, and every endeavor will be made to obtain competent industrial engineers and trade specialists.

* * *

In World War II, hollow welded propeller blades made of American steel proved invaluable because they withstood the destructive "pitting" effects of flying sand and gravel in North Africa and other desert war areas.

Die Design and Diemaking Practice

DIE DESIGN AND DIEMAKING PRACTICE—Third Edition. Edited by Franklin D. Jones. 1083 pages, 6 by 9 inches; 661 illustrations. Published by THE INDUSTRIAL PRESS, 140-148 Lafayette St., New York 13, N. Y. Price, $7.

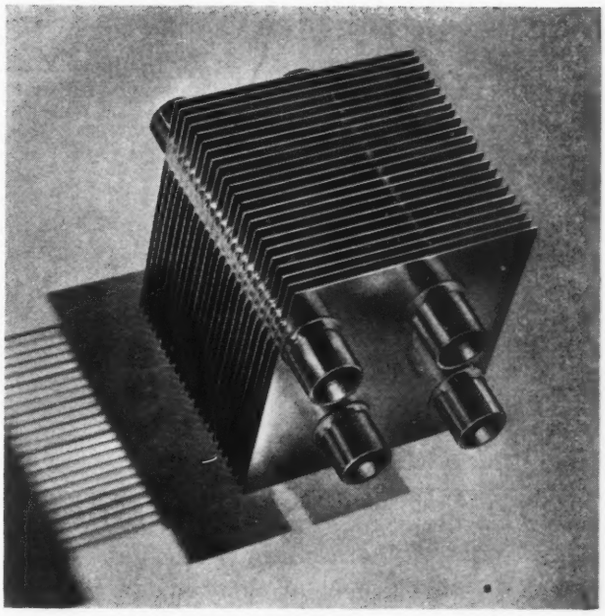
The material in the third edition of this book, just published, has been extensively revised. Five new chapters have been added, the cross-index expanded, and a detailed table of contents, listing important subjects in each chapter, has been provided to aid in finding needed information.

The new chapters cover the following subjects relative to sheet-metal working dies: Materials Used in Diemaking; The Use of Rubber in Conjunction with Press Tools; Pointers on the Design of Stampings; and Heat-Treatment of Die Steels. A chapter on designing dies for powdered-metal parts has also been added.

The other twenty-two chapters in this edition deal with the following subjects: Dies for Cutting Blanks from Flat Stock; Methods of Determining Blank Diameters; Laying out Blanking Dies, and General Diemaking Practice; Punch and Die Details; Stops for Controlling Position of Stock; Sectional Punch and Die Construction; Blanking Dies for Rotor and Stator Laminations; Piercing and Perforating Dies; Sub-Press or Self-Guiding Dies; Action of Metal in Shearing and Wear of Cutting Edges; Bending and Forming Dies; Classes of Drawing Dies and General Designing Information; Dies for Drawing Shallow Cups or Shells; Dies for Drawing Deep Shells; Dies for Drawing Shells Having Wide Flanges; Drawing Dies for Conical or Tapering Forms; Deep-Drawing Operations on Conical-Shaped Parts; Drawing Dies for Spherical and Oval Shapes; Drawing Square and Rectangular Shapes; Expanding Dies of Rubber and Hydraulic Types; Dies for Special Operations; and Designing Dies for Inclinable Presses.

All designs illustrated and described in this book are the work of die design specialists, and have been successfully used in industry. The data presented on various phases of diemaking practice and die materials represents a wide collection of costly die design experience in condensed, ready-reference form. Dies of the same general class are grouped together in chapters, and in some instances, as in the case of drawing dies, these general types are further subdivided for convenient study.

This treatise does provide an unusually comprehensive reference source and an eminently practical working guide for designers, diemakers, and tool engineers.



In this heating and cooling coil, stainless-steel tubing was bonded to the fins by a mechanical process, no welding or soldering being required

Tubes Bonded to Heating and Cooling Coil by Mechanical Joint

A section of a heating and cooling coil with stainless-steel tubing (5/8 inch in diameter by 0.049 inch wall thickness) bonded to the fins is shown in the accompanying illustration. The joint between the tubes and fins is purely mechanical, no welding or soldering being employed in the assembly.

The method of producing the joint is as follows: Plate type stainless-steel fins are stamped and belled, forming a bonding collar at each opening. This provides a broad, flat surface instead of a sharp edge at the point of contact with the tube. A tool-steel "bullet," propelled by compressed gas, is forced through the tube, expanding it uniformly against the continuous surface formed by the collars of the fins. It is claimed by the manufacturer that the resulting mechanical bond successfully withstands the repeated expansion and contraction caused by heating and cooling cycles.

In developing this corrosion-proof heat-exchange unit for heating and air-conditioning work, the Trane Co. of LaCrosse, Wis., paid particular attention to the tolerances and finishes of the stainless-steel tubes used. To meet the exacting requirements involved in expanding tubes through the use of tool-steel "bullets," tubes made to considerably closer than standard tolerances were necessary. The tubes employed in this application were supplied by the Carpenter Steel Co., Union, N. J.

THE SALES ENGINEER AND HIS PROBLEMS

By BERNARD LESTER
Lester and Silver
Sales Management Engineers
New York and Philadelphia

Will They "Smile Back" by the End of This Year?

EVERY wise general, following an action period, stops to size up gains or losses, present position, and future procedure. Then he makes decisions. The New Year is the best time for the machine equipment salesman, as well as his own management, to do just this.

Any of us should feel proud of a fine record of orders. Yet, in letting matters rest there, we may hamper future success. We must size up ourselves, and then plan for a future surely marked by change and uncertainty.

One common weakness is to depend too much on emotional appeal rather than fact. "Death of a Salesman"—a tragedy of conflict well on toward two years old—has packed theaters in many cities here and abroad. The impact of its message is terrific. Willy Loman, the frustrated salesman, finally kills himself in a frenzy of emotion. Not a single business friend appears at his funeral—only Charley, a friendly neighbor.

Charley's final words are heard as an off-stage pronouncement upon the background of a life. "Willy was a salesman. And for a salesman there is no rock bottom to the life. He don't put a bolt to a nut; he don't tell you the law or give you medicine. He's a man way out there in the blue, riding on a smile and a shoeshine. And when they start not smiling back—that's an earthquake."

We can well ask ourselves: Are we, too, "floating in the blue on a smile and a shoeshine"? Willy never could see himself. He always interrupts. He struggles up and up on a scaffold of emotion. Finally it crashes beneath him. His main theory is that success depends only upon "who you know," not on what you know and how you direct your appeal. To Willy the "what" and the "how" are meaningless.

Of course, none of *us* is a Willy. But too many of us may simulate Willy in some degree by trying to "bull it through" without facts. The prospects "start not smiling back." The order slips. We are left wondering and blaming. And what's more, friendship tumbles and is lost. Like Willy, we are alone trying to figure why customers don't like us.

Frankly, that is the history of too many failures in all forms of selling. The whole basis today of permanent success in selling machinery and other shop equipment is first to know our product—its applications and the multiplying problems of those who might use it—and second, to be able to demonstrate our knowledge in an acceptable manner.

What faces us in the year ahead? At least the merging of a war and peace economy; new products and processes to tax our genius and skill. Final victory in meeting competition is a race to find the best way to solve new problems of production, rather than the ability just to fill our plants with work.

Anyone entering our war economy, which will probably be of long duration, can bag a good sales volume and satisfy his plant capacity. But how hard it is to choose wisely between just getting an order and solving a customer's problem that may provide a growing opportunity in the future. The importance of wise choice is tremendous in times such as these. It can only be made intelligently by salesmen and managers who understand the whirl of progress in materials and methods and the accelerated limits of accuracy.

"Can you quote on this?" asks the prospect. "Sure," answers the salesman. But besides getting an order, what will it contribute both to the war economy and to his own position in the future? Perhaps this is a job that our opportunist competitors, with limited skill, can best handle. Perhaps we should reserve our talents for another job that may help military preparation,

and will also make possible the use of our best talents, leading to more progressive and profitable areas of performance. How successfully we sell may depend upon to whom we sell.

Many of us may be faced with more business than our plants can handle in a reasonable time. In such cases, instead of expending our activities on getting new orders, we may turn our attention to other important questions. Are the tools we have sold and installed giving maximum performance? Are there chances to sell maintenance parts or give some service that shows we are "long-range" salesmen?

Management and sales engineers alike may well pause, consolidate their position, and give thought to past inadequacies. Otherwise, like Willy Loman, "floating in the blue on a smile and a shoeshine," there may be "an earthquake" because our customers "start not smiling back."

* * *

SKF Employe Education Program

The employe education program inaugurated by SKF Industries, Inc., Philadelphia, Pa., a year ago was so successful that it is being resumed this year. Approximately 150 factory workers are enrolled in after-hour classes in eight courses that require from ten to twenty weeks for completion. Classes are taught by skilled instructors, who are also company employes. Courses include blueprint reading, use of the slide-rule, shop mathematics, advanced mathematics, quality control, use and care of precision measuring instruments, and metallurgy.

* * *

Electric Industrial Truck Association Elects New Officers

At the annual meeting of the Electric Industrial Truck Association, held in Philadelphia recently, the following officers were elected for the ensuing year: President, C. B. Cook, vice-president and export sales manager of the Elwell-Parker Electric Co., Cleveland, Ohio; and vice-president, Elmer F. Twyman, vice-president in charge of the Philadelphia Division of the Yale & Towne Mfg. Co. William Van C. Brandt, managing director of the Association, was re-elected secretary and treasurer.

* * *

Monel rustproof nuts have been used successfully on steel bolts by certain chemical plants, thus eliminating the possibility of the nuts freezing to the bolts.

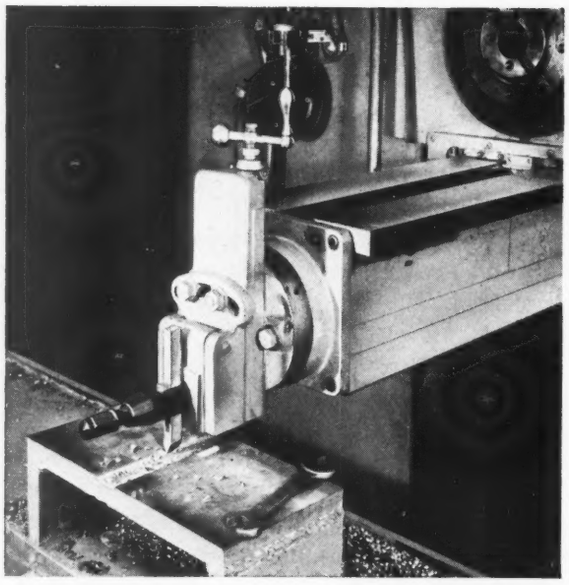
Production of Small Medals Increased by Automatic Sand-Blasting

Increased production of fine medals, plaques, and medallions for industry, schools, government, and religious organizations at the plant of the Medallic Art Co., New York City, has been greatly increased by a novel application of automatic sand-blasting equipment manufactured by Leiman Bros., Inc., Newark, N. J.

In the manufacture of small medals—ranging in size from 1/2 inch to 5 inches in diameter—the sculptor's original design is duplicated in a set of steel dies that are used to stamp out the individual pieces or medals from strips of metal. The stamped pieces are then sand-blasted to produce a matte or dull finish, using Leiman rotary sand-blasting machines, as shown in the illustration. In these machines, the pieces are held on a circular revolving table which passes through a blast of air charged with flint abrasive. As many as 1200 to 1500 pieces, 1 1/4 inches in diameter, can be completed in one hour.

After being sand-blasted, the pieces are darkened by chemical oxidation and then relieved by hand-rubbing with wet pumice to bring out the highlights and thus add beauty and definition to the medals.

Finishing small medals and plaques with automatic sand-blasting equipment



The Latest

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Edited by FREEMAN C. DUSTON

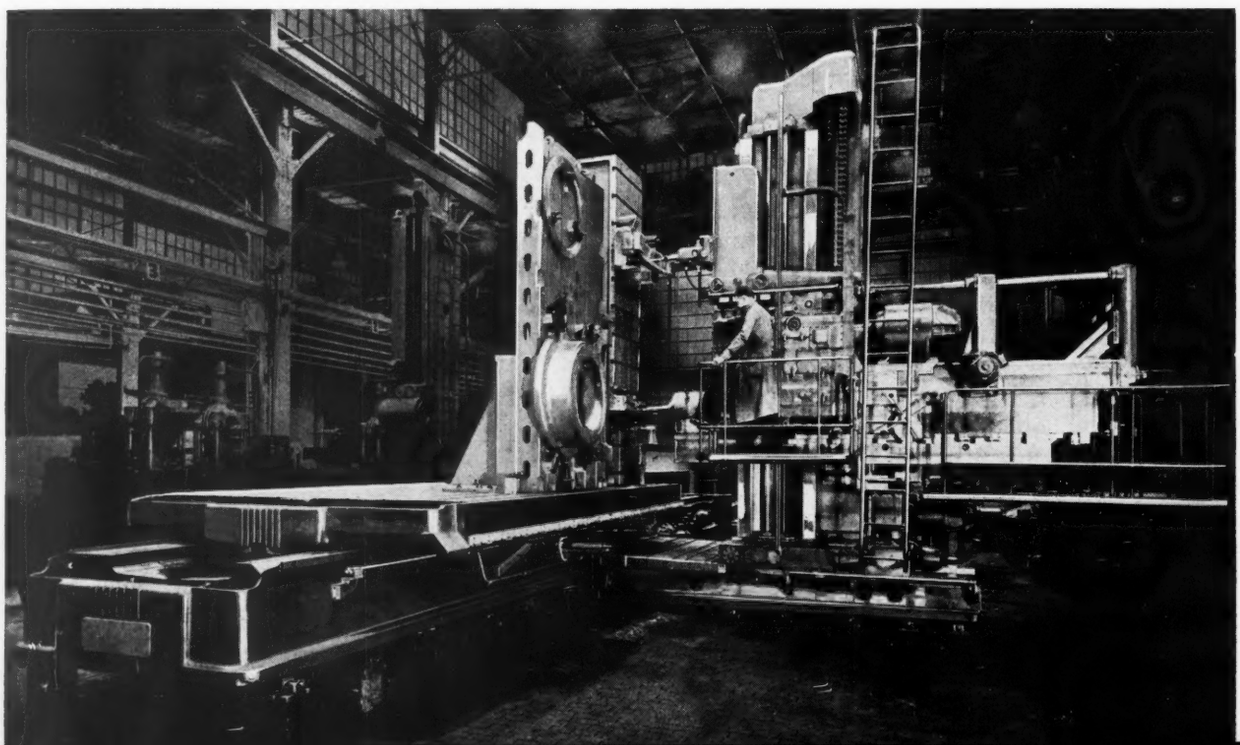
Giddings & Lewis Planer Type Horizontal Boring Machine with Power-Operated Under Arm and Tracer Control

The addition of new structural features to the planer type horizontal boring, drilling, and milling machine built by the Giddings & Lewis Machine Tool Co., Fond du Lac, Wis., has greatly increased its working range and capacity. New design principles built into this single, general-purpose machine tool, as shown in Fig. 1, have been especially developed to meet the diversified requirements of a large automobile manufacturer. The new tracer control, Figs. 2 and 3, and the power-operated under-arm ram and spindle support shown in the heading illustration and in Fig. 4 make it possible for this machine to handle a wide range of work in automotive plants which would ordinarily require several special production machines.

The new machine is especially adapted for the rapid machining of body and fender dies and forging dies, as well as for milling, drilling, and boring work-holding jigs and fixtures; for manufacturing special press equipment or press components; for general maintenance of large production machines; and numerous other jobs.

In designing this multiple-purpose machine, special engineering consideration was given to the size, shape, and weight of the parts to be machined; number of settings required to complete all machining operations; over-all machining time necessary to finish the job; advantages of using a tracer control and a profiling attachment; and simplification of

Fig. 1. Giddings & Lewis planer type horizontal boring, drilling, and milling machine provided with duplicating attachment for die-sinking, profile milling, and contour machining



in Shop Equipment

machining operations by providing for spindle extension and ample support with an under arm.

To meet these requirements, it became necessary to take advantage of the standard machine movements and feeds. For example, provision is made to permit placing a work-piece on the 60-by 156-inch machine table and cross-feed the table a full 120 inches. If the part is unusually large or of odd shape, where table overhang might occur, the machine column can be traversed 48 inches on its runway at right angles to the table. The spindle end support column also moves on its runway to facilitate table overhang on the opposite side for back-boring, back-facing, etc. A third movement, that of the headstock on the column, provides a 72-inch travel above the table.

Regardless of the size or shape of the work, it is usually possible to locate it close enough to the machine headstock so that it is unnecessary to extend the spindle beyond reasonable limits to machine surfaces that are hard to reach. In some instances, however, if it is necessary to extend the spindle to perform "pick-up" operations, this is done by employing the power-operated under-arm ram type support.

Ordinarily only one or two settings are required to complete the majority of work routed to the machine. As a result of the versatility of the machine and its ability to bore, mill, face, back-face, counterbore, ream, drill, and tap by merely changing cutting tools, it is unnecessary to move the work from one machine to another. With the added advantage of tracer control on the new machine, it is practical to profile and contour-mill sections or parts of the work-piece without disturbing the setting. Consequently, time-consuming work set-ups for different machining operations on other machines are eliminated.

The built-in power-operated under-arm ram and spindle support permits the under arm to have a travel of 60 inches and to rigidly support the spindle and auxiliary attachments used for machining at that distance from the face of the headstock. The under arm has twenty-one power feeds identical with those of the spindle. The spindle and under arm can be operated independently or engaged for feeding simultaneously.

Used independently, the under arm simulates a shaper ram, and when equipped with a clapper-box shaping attachment as shown in the heading illustration, it readily performs pick-up machining operations on large, cumbersome parts which might create unusual set-up problems if the original setting is changed. The shaping attachment is especially useful in machining pads and bosses and in cutting keyways, slots, etc. Or, when the ram is equipped with a plain angular milling attachment, it is possible to machine internal and external surfaces that often present a difficult problem. Simple broaching and press fitting operations are other practical functions of the ram.

To prevent deflection when the spindle is extended to its extreme length, an anti-friction roller bearing support is placed on the ram. This unit makes it possible to perform accurate boring, milling, and drilling operations with the machine spindle extended 5 feet from the headstock face.

Profiling, contour-milling, and die-sinking operations are readily performed on the new machine by using the electrically operated tracer control. This control is employed as auxiliary equipment, and operates the different machine units to complete the work. The tracer control attachment is provided with a ball swivel type arm and tracer tip. The latter contacts and follows the templet guide. Sliding adjustment of the tracer

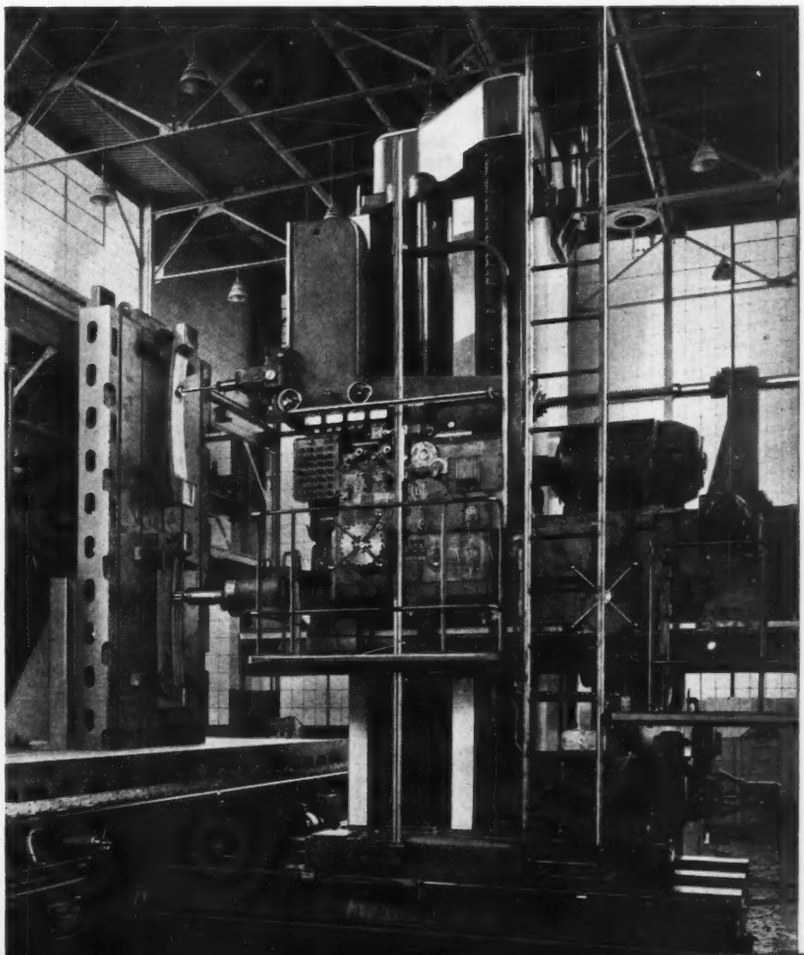


Fig. 2. Auxiliary tracer control attachment of new Giddings & Lewis machine reduces the contour-milling of a bumper die to a simple duplicating operation

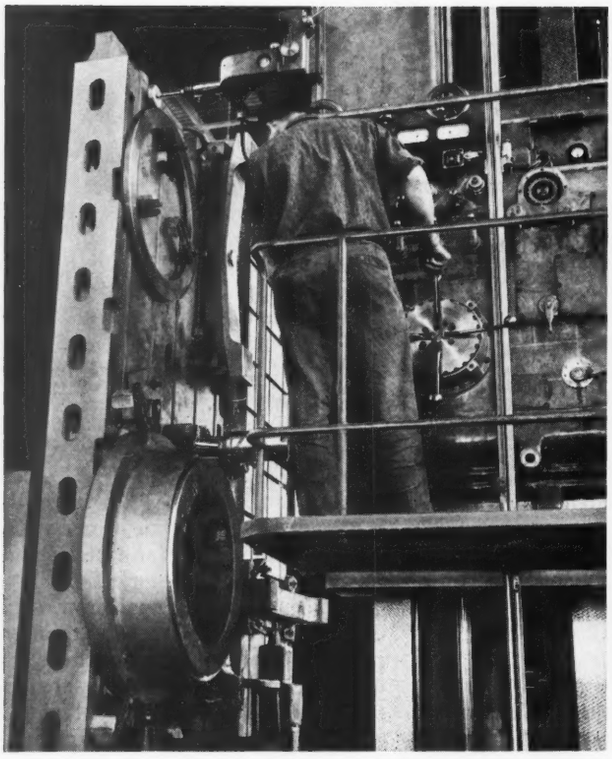


Fig. 3. Tracer control set up on Giddings & Lewis machine for profile-milling operation on circular steel casting

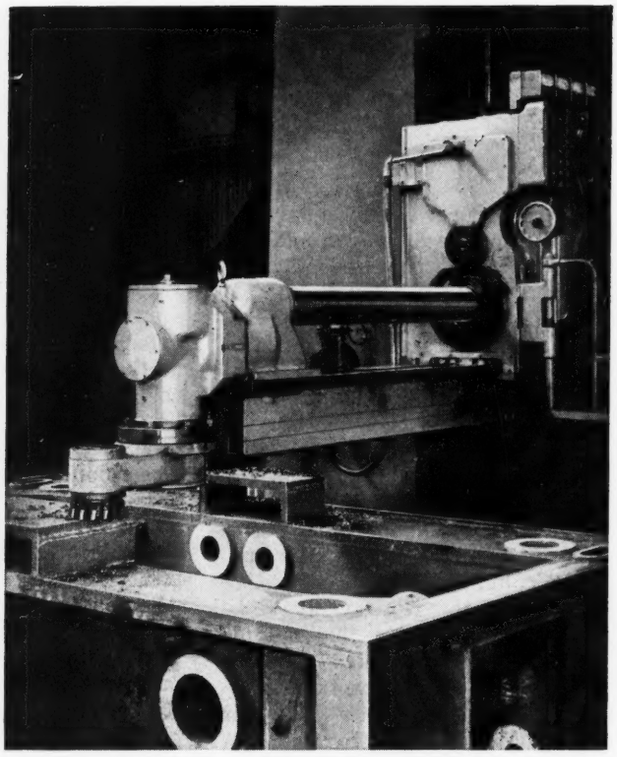
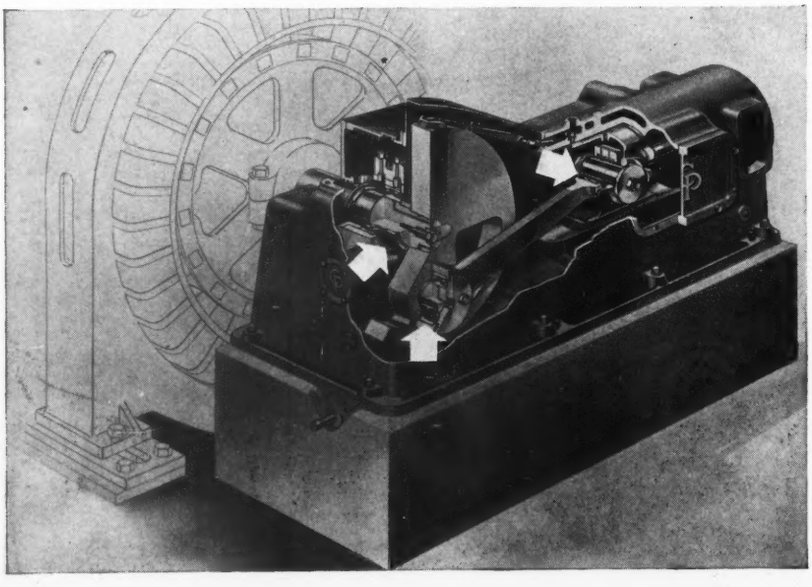


Fig. 4. Offset spindle, 90-degree angular milling attachment of new machine finishes hard to reach surfaces

arm on a vertical holding column, which is mounted on the machine headstock, enables the operator to make easy set-up adjustments. Also, this arrangement makes it possible to use the full vertical headstock movement of the machine. This feature, coupled with the table cross-feed, provides an unusually wide work pattern.

In operation, the tracer-arm tip contacts the templet from either the end or side, and activates the motors that provide power for the different machine feeds. These include vertical headstock feed, table feed, and column feed. All respond instantaneously to the tracer control mechanism. Through this auxiliary machine attachment, it is practical to perform duplicating work of almost any size—small or large—which would ordinarily be assigned to equipment designed only for one particular range and class of work.

All features of the regular Giddings & Lewis planer type horizontal boring, drilling, and milling machine are incorporated in the new machine, including two spindles (one a low-speed type for heavy-duty work and the other a high-speed type for sensitive drilling and tapping); speed and feed selectors; synchronized movement of headstock and end support block to insure positive bar alignment; and safety devices for traversing units. ----------53

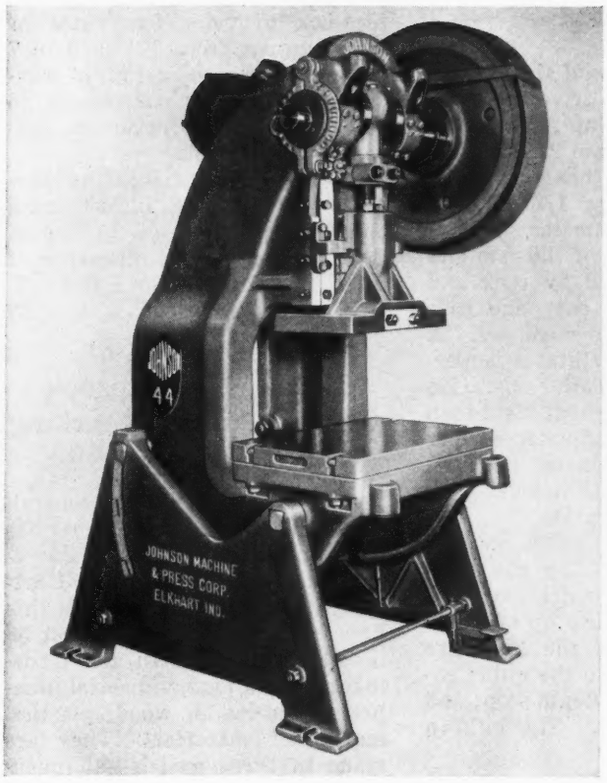


Motor-driven compressor with anti-friction roller bearings introduced by the Chicago Pneumatic Tool Co.

Horizontal Duplex Motor-Driven Compressors with Anti-Friction Bearings

Spherical roller main bearings support the crankshaft and crankpin end and double-row needle bearings are used in the crankhead end of the connecting-rod in the line of horizontal duplex motor-driven compressors now being manufactured by the Chicago Pneumatic Tool Co., New York City. The advantages of roller bearings have always been recog-

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Punch press designed to handle intermediate size work, placed on the market by Johnson Machine & Press Corporation

Hydraulic transfer press for molding rubber parts, built by the Elmes Engineering Division, American Steel Foundries

nized by compressor design engineers, but it has been impractical to use them in side crank type compressors because the main bearings are installed between balanced crank disks permanently attached to the shaft ends. In the past, removal and replacement of the crank disks or main bearings was a difficult operation, requiring heavy, special equipment. The recent development of the oil injection system of bearing removal, makes the application of roller bearings throughout a comparatively easy matter.

The roller bearings have the advantage of being self-adjusting, and thus eliminate all chance of misadjustment in maintenance—a frequent cause of bearing failures or cross-head seizures that result in major damage to compressor frames or running gear components. After the bearings are installed, no further "down time" or run-in adjustment is needed.

Long life, smooth and quiet operation, and full-flood lubrication are advantages gained by using anti-friction bearings in compressors. The full-flood lubrication method is suited to roller bearing design, and eliminates complicated pumping mechanisms. 54

Johnson Intermediate-Capacity Punch Press

The Johnson Machine & Press Corporation, Elkhart, Ind., has placed on the market a Model 44 geared type punch press adapted for intermediate class work, which is capable of exerting 43 tons pressure at the bottom of its stroke. This press is especially designed for trimming die-castings and light sheet-metal work, and is available in both flywheel and geared types. It has heavier side arms, a longer stroke, a greater bed area, and a larger ram face than most conventional punch presses in its size range. A 21-inch opening through the back of the press provides clearance for exceptionally large work.

The new press occupies a floor space of 67 by 52 inches, is 95 inches high, weighs approximately 8000 pounds. It is driven by a 3-H.P. motor which operates at 1800 R.P.M., and is capable of a ram speed of forty-six strokes per minute. The die space from bed to ram face with the stroke down and the adjustment up is 11 1/2 inches. Additional shut height up to 20 1/2 inches can be provided if desired. 55

Elmes Transfer Press for Molding Rubber Parts

A hydraulic transfer press especially designed for molding small rubber parts around metal inserts is announced by the Elmes Engineering Division, American Steel Foundries, Cincinnati, Ohio. Parts are produced on this machine at the rate of twenty units per two-minute cycle.

This press is equipped with two transfer rams, each of 20 tons capacity. The downward moving die clamp has a capacity of 60 tons. The lower halves of the die are mounted on a three-station rotating table, which provides nearly continuous processing of material and permits curing and unloading while the material is being molded in the die.

The press has semi-automatic timed cycle controls with push-button operation, including "inching" features for all movements. The rotating table is mounted on a circular steam plate to maintain the proper die temperature when the dies are out of the pressing position. The clamp is provided with a smaller steam plate. Automatic controls maintain a constant temperature. 56

To obtain additional information on equipment described here, use Inquiry Card on page 229.

Universal Vertical Milling Machine

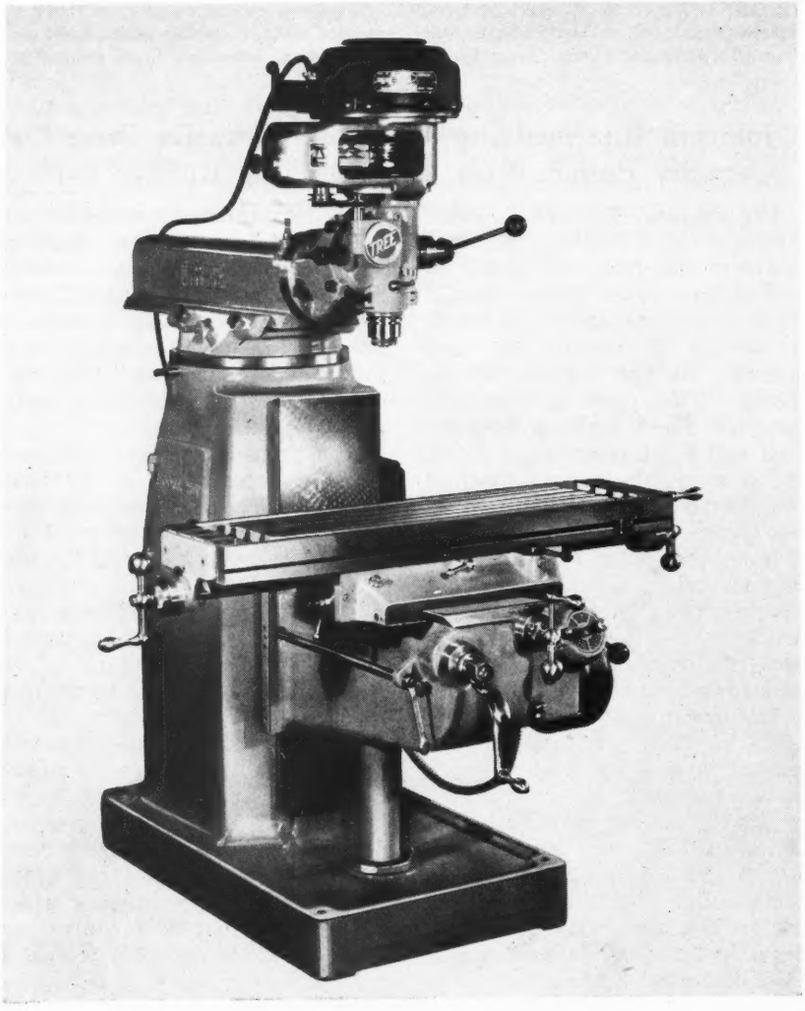
The Tree Tool & Die Works, Racine, Wis., has just started production on a Model 2UV universal vertical milling machine. This precision milling machine has a 45-degree dovetail column and extended knee construction, and is said to have the rigidity, weight, and range of a conventional No. 2 size milling machine. A universal vertical head for angle milling, drilling, and boring gives this machine exceptional versatility.

A feature of the machine is the provision for movement of the vertical head up to and including 45 degrees across the table each way from the vertical position. This permits taking angular milling cuts the length of the longitudinal table feed without resetting. The head can also be rotated 90 degrees each way in a plane parallel with the table axis. The turret on which the head is mounted can be rotated 360 degrees. A 1-H.P. axial air gap motor is provided to drive the spindle at speeds ranging from 140 to 3500 R.P.M. or from 210 to 5200 R.P.M. The head has a capacity for end-mills from 1/8 inch to 1 1/2 inches in diameter.

All adjustments of the ram and head are controlled by rack and pinion to provide easy and safe movement of these members. A counterbalance facilitates supersensitive hand or power operation of the quill throughout its 4-inch travel range. The adjustable roller spindle drive eliminates backlash and makes possible heavier cuts and smoother operation.

The automatic collet closing mechanism for holding tools and cutters facilitates quick easy tool changing and setting up of work. Other features of the head are power down feed to the quill; enclosed micrometer depth stop; and positive quill lock. The built-in feed-box provides five rates of feed ranging from 3/4 inch to 7 inches per minute, and rapid traverse of 70 inches per minute to the longitudinal movement imparted to the table.

The table has a working surface of 10 1/2 by 42 inches, and a longitudinal travel of 25 inches. The driving equipment consists of a 1-H.P. spindle motor and a 1/2-H.P. feed-box motor. 57



Universal vertical milling machine built by the Tree Tool & Die Works

Noble & Westbrook General-Purpose Marking Machines

A complete new line of general-purpose marking machines has been announced by the Noble & Westbrook Mfg. Co., East Hartford, Conn. The machines in this line, known as the Noblewest 50 Series, are all suited for trademarking and part and serial numbering on metal, wood, plastics, and other materials. They are made in three models—all pneumatic, semi-pneumatic, and hand-operated.

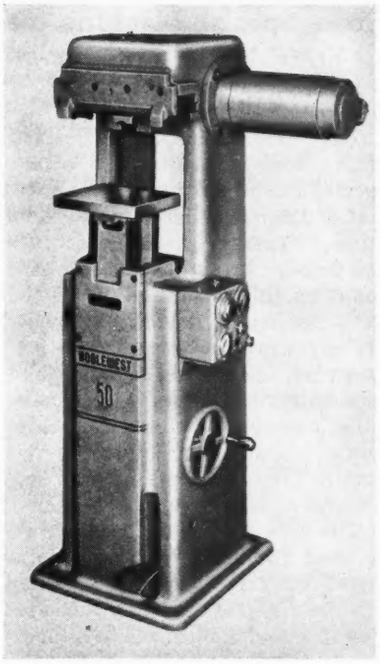
These machines use the "Noblewest" roll-marking process of forming enduring impressions on flat or round surfaces, including precision graduating, numbering, and knurling. This process avoids shock to either the marking die or the piece being marked, and is used to mark such close-tolerance parts as piston-rings without straining or distorting them.

The all-pneumatic Model 50PI machine will mark up to 1200 pieces per hour. Both the table and die slide are powered independently by heavy-duty air cylinders. The machine is connected directly to the shop air lines. Only one air control adjustment is needed in setting up this machine.

In the semi-pneumatic Model 50P marker, the table is operated by air pressure, but the die slide is easily drawn across the work-piece by means of a manual lever adjusted to a natural pull. The production rate is 400 to 650 pieces per hour. An air ejection unit for removing marked pieces from the table can be used.

The Model 50 machine is of the same design and construction as the two pneumatic models, but is entirely manually operated. The table is raised by a foot-pedal, and the marking die is carried across the work-piece by the same "natural pull" hand-lever used on

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Noblewest all-pneumatic operated general-purpose marking machine

the semi-pneumatic model. This machine will mark 300 to 500 pieces per hour, depending on the speed of the operator. 58

Airco "Thor-Tung" Electrodes for Inert-Gas Shielded Arc-Welding

A "non-consumable" electrode containing thoriated tungsten, known as "Thor-Tung," has been developed by Air Reduction, New York City, for use in "Heliwelding," an inert-gas shielded arc-welding process. The new electrode is said to have proved exceptionally useful in direct-current straight-polarity welding. Actual tests have shown that it is much cooler in operation than ordinary tungsten electrodes, and thus permits the use of higher currents on electrodes of a given size. It is also said to have excellent arc stability, not only on these high currents, but on currents lower than those that can be used with conventional tungsten electrodes.

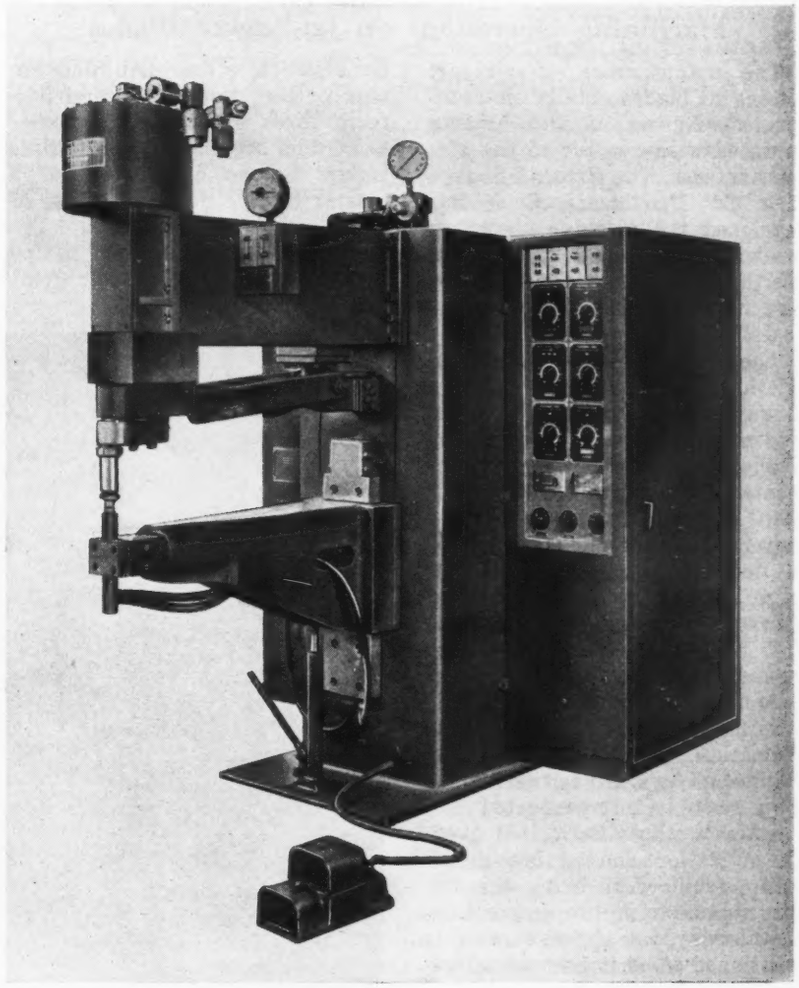
Since the new electrode is cooler running and does not become molten, consumption is almost negligible and contamination resulting from accidental or deliberate "touching" is eliminated, so that touch-starting can be employed even at low currents.....59

Sciaky Resistance Spot-Welder for Aluminum, Ferrous, and Non-Ferrous Alloys

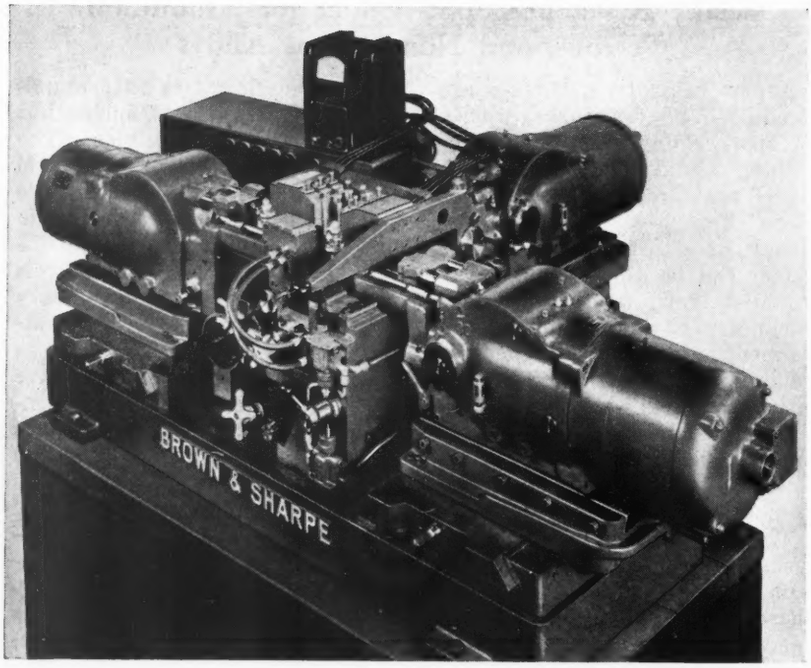
A new press type, three-phase "Modu-Wave" resistance welder for spot-welding aluminum, magnesium, stainless steel, Inconel, Monel, brass, mild steel, and other alloys has been developed by Sciaky Bros., Chicago, Ill. This welder can be quickly and easily adjusted for welding various thicknesses of any one of the metals mentioned. It is designed for welding to Army and Navy specifications, and will weld heavy thicknesses of aluminum, such as used for various aircraft components, including the primary structural members.

The patented Sciaky three-phase system is said to use up to 75 per cent less current than a single-phase welder and to operate at a much higher power factor. The welder is rated at 100 K.V.A. at 50 per cent duty cycle and operates on 220- and 440-volt, three-phase, 60-cycle current. The standard throat depth is 36 inches but other depths are available. The welding range on low-carbon steel is from 0.022 to 0.156 inch (two thicknesses) and on aluminum and magnesium alloys from 0.025 to 0.081 inch. Pulsation controls are provided for welding heavy gages of ferrous alloys. The heating and cooling time, as well as the total number of successive alternating pulses, can be controlled. An adjustable pressure regulator for controlling the time at which the forging pressure is applied in relation to the peak of welding current is provided to assure maximum weld quality regardless of gage thickness.

When welding two or more pieces of different thicknesses, uni-directional current is used to insure proper welding by employing a toggle control switch. 60



"Modu-Wave" resistance spot-welder for ferrous and non-ferrous alloys, announced by Sciaky Bros.



Special machine developed for operations on jet-engine blades

B & S Electronic Equipment Designed to Speed up Machining Operations on Jet-Engine Blades

The manufacture of aircraft jet-engine blades entails the accurate machining of the holding surfaces with respect to the airfoil surfaces. The Brown & Sharpe Mfg. Co., Providence, R. I., has developed the machine shown in the accompanying illustration for positioning the blade and drilling center holes used for location purposes in a subsequent operation.

The blade is supported in a nonfrictional reed-mounted cradle, arranged to pivot adjustably about two axes, and is adjustable vertically. Any one of the three movements can be controlled independently without affecting the other movements. Proper positioning is effected by observing six strain-gage indicator points that are in contact with the airfoil surface and adjusting the three movements to the "zero" position.

A multiple-position switch permits selection of individual gage indication for set-up purposes. Additional switch positions cause all gages to be interconnected electrically to show individual average indications for the three movements required to bring the airfoil surface to its proper position. In this way, the airfoil surface is positioned so as to be least affected by errors in the blades.

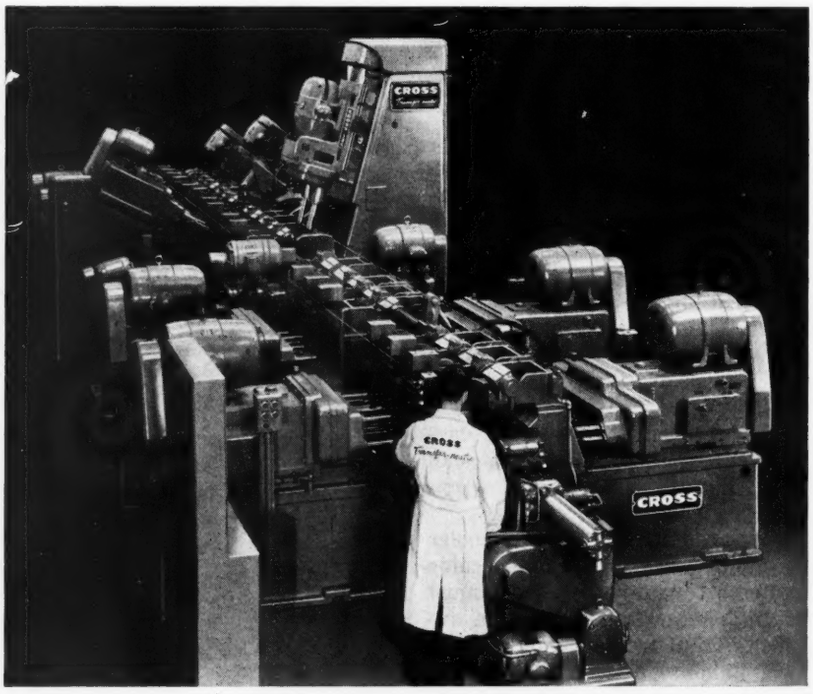
After positioning the blade, a switch is operated, causing three combination center-drill and facing cutters to advance and perform three operations on bosses located on the blade. The machine set-up is accomplished from a master blade. Seventeen sizes of blades are accommodated. The estimated production rate is 100 blades per hour. ----------61

Cross Special Machine for Finishing Automatic Transmission Cases

The Cross Company, Detroit, Mich., has recently built a new special machine for finishing automatic transmission cases. Like other "Transfer-matic" machines previously brought out by the company, this machine is equipped with automatic devices to transfer parts from station to station. It drills, chamfers, reams, and taps thirty-two holes in the ends, sides, and tops of eighty-five automatic transmission housings per hour. These operations are performed at twenty-eight stations.

The first station of the machine is used for loading, and is followed by seven drilling and five idle stations for the ends; one station for indexing; and ten drilling and four idle stations for the sides and top. Eighty-three tools are used for the machining operations. Only one unskilled operator is required for this machine, since the parts move automatically from station to station.

The machine is provided with the recently announced Cross machine control unit with "Toolometers" which automatically stop the machine when the tools need changing. With this equipment, pre-set tools eliminate "down time" adjustments for tool changing. The control board instantly



Cross special machine for finishing automatic transmission cases

To obtain additional information on equipment described here, use Inquiry Card on page 229.

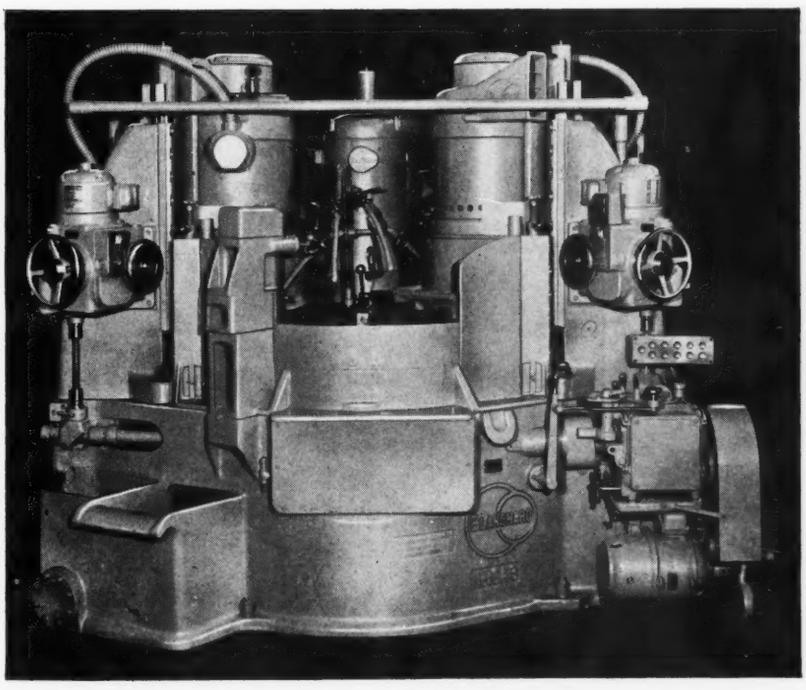
identifies the station at which tools need to be changed and enables the operator to group tool changes, thus further reducing "down time." Other features include hydraulic feed, rapid traverse, and the use of standard Cross sub-assemblies to facilitate maintenance. 62

Blanchard Multi-Spindle Rotary-Table Surface Grinder

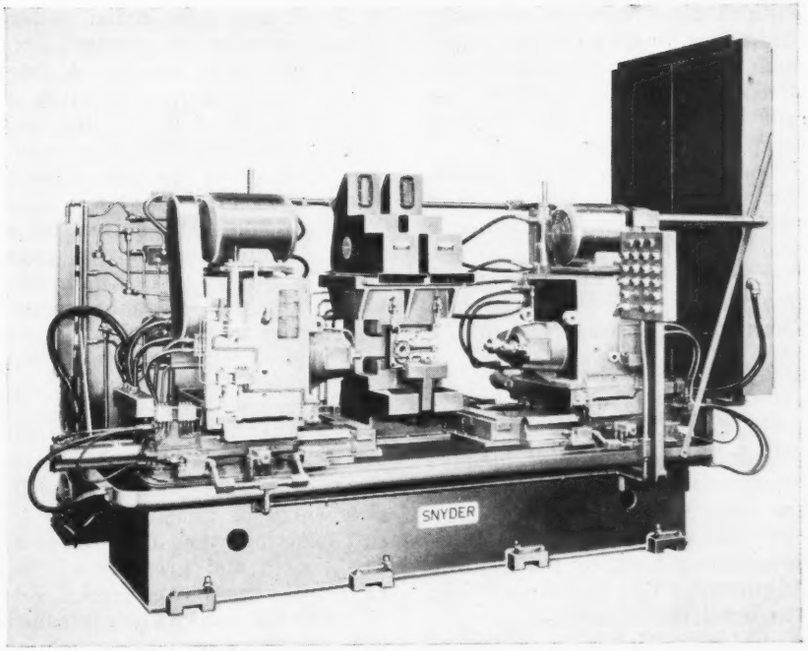
The Blanchard Machine Co., Cambridge, Mass., has announced the development of a new vertical-spindle rotary-table surface grinder. This grinder can be equipped with a magnetic chuck, 40 inches in diameter, or a plain table to accommodate a fixture for holding non-magnetic work or pieces of irregular shape.

The new No. 16A3 grinder is equipped with three abrasive wheels. All three wheels can be set to grind the same surfaces when stock removal is heavy or when very accurate tolerances are required for dimensions or surface finish. The spindles can be set to grind surfaces at the same or different heights and at different distances from the center of the chuck. In the example illustrated, two spindles are driven by 30-H.P. motors, and one by a 15-H.P. motor.

The twenty-four station fixture designed for use on this machine is arranged for automatic clamping and releasing, and for grinding connecting-rods with wrist-pin bosses at an offset height. All grinding wheels are under the control of an automatic caliper or sizing device, which in ordinary practice, will hold dimension variation within a total range of 0.001 inch. 63



Blanchard multi-spindle rotary-table surface grinder with automatic sizing device



Special machine built by Snyder Tool & Engineering Co. which automatically weighs connecting-rods and removes metal to obtain accurate balance

Snyder Special Automatic Connecting-Rod "Balancing-Milling" Machine

A special machine for "balancing-milling" forged steel connecting-rods to within less than 2 grams variation in over-all weight at a production rate of 144 to 180 pieces an hour has been built by the Snyder Tool & Engineering Co., Detroit, Mich. Operation is entirely automatic after locating the work-piece and pressing the cycle button.

When the operating cycle button is pressed, the work-piece is automatically weighed. The scales register the amount each end is out of balance and transmit to the units on both sides signals that set up these units for removing the correct amount of stock. The part is then clamped by an automatic hydraulic mechanism, and both units advance to the part finder. The lower unit stops and the cross-slide feeds the cutter across the part. The units then return to their original positions, the fixture opens, and the scale gives a visual check as to whether the parts are in balance.

Balancing is accomplished in the one-pass milling operation, and conforms to tolerances of 1/16 ounce on either end and in over-all weight. The machine is equipped with a safety switch which automatically returns the

To obtain additional information on equipment described here, use Inquiry Card on page 229.

units if stock removal necessary for balance would go beyond maximum allowable machining dimensions. Such parts, however, can still be salvaged, thus reducing scrap to a minimum.

The machine is of the double-end, single-station type, with welded steel base. It requires a floor space of 62 by 129 inches. The 1 3/4-inch diameter tungsten-carbide tipped end-mills are operated at a speed of 654 R.P.M. A V-belt and gear drive to the spindle provides the required flexibility in spindle speeds. A feed of 30 inches a minute gives a chip thickness of 0.0075 inch per tooth. The lower slide has a 10-inch stroke, and the cross-slide a 6-inch stroke.

The spindles are driven by a 3-H.P. motor mounted on each head. A 2-H.P. 1200-R.P.M. motor drives the hydraulic pump. Lubrication is automatic. 64

Denison High-Production Oil-Hydraulic Press

Fast action and high-tonnage pressures under accurate control are outstanding advantages of a new oil-hydraulic 50-ton Multipress brought out by the Denison Engineering Co., Columbus, Ohio. The precision adjustments of this press for multiple ram action are designed to give unusual flexibility for applications in various industries. The press has a 15-inch stroke, a 24-inch daylight opening, and a work surface of 31 by 19 1/2 inches.

The ram approach speed can be preset at any rate desired up to a maximum of 290 inches per minute, with independently adjustable pressing speeds up to 145 inches per minute. This permits adjustments for rapid traverse with slow entry of punch into die to suit exacting work requirements. The length and pressure of the ram stroke can also be preset. Reversal of the ram can be controlled either by pressure or length of travel on all models.

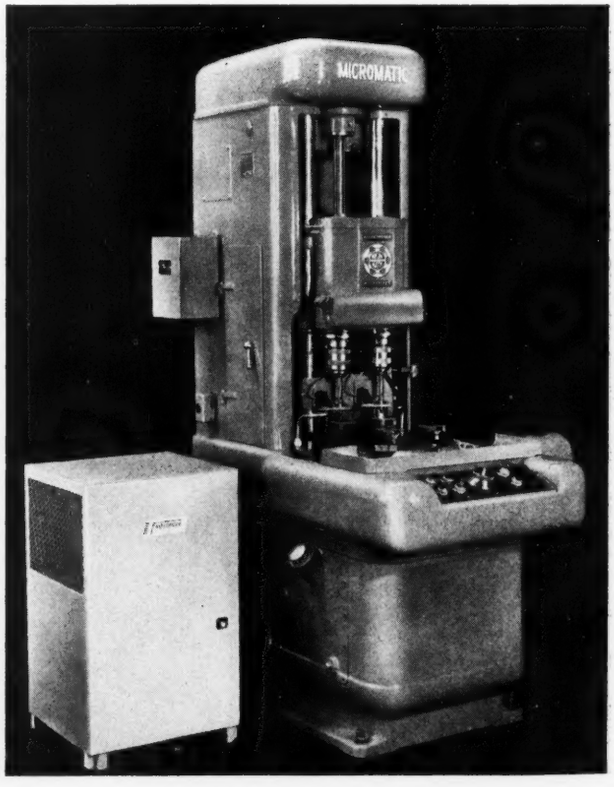
The press can be equipped with a choice of controls, including dual hand-lever, single lever, foot-pedal, or electric push-button types. It is available in both manual and automatic models for single cycling, continuous cycling, or vibratory repeat strokes. Automatic ram cycling can also be used in conjunction with variable-speed approach and interlocking hydraulic accessories. Another advantage is inching control of ram for quickly locating dies and tooling during set-up operations.

A 33-inch diameter hydraulic indexing table can be installed on these presses as added equipment. The Denison table accessory moves parts under the press ram automatically, and provides indexing movements for either six or twelve stations. Parts can be loaded on the table stations at the front of the press, eliminating waiting periods for completion of work cycles. The revolving table, synchronized hydraulically with the ram action, accurately positions the parts at the pressing stations. Provision is made for skipping non-tooled stations on the index table. The design permits rapid change-over of dies and fixtures on press and indexing table.....65

Frostrode Industrial Fluid Coolers

Industrial fluid coolers designed to accurately control the temperature of honing, grinding, and cutting oils and water, as well as hydraulic oil and plating solutions, are being manufactured by the

High-production, high-tonnage oil-hydraulic press announced by the Denison Engineering Co.



Micromatic Hydrohoner with Frostrode fluid cooler for supplying coolant at specified temperature

To obtain additional information on equipment described here, use Inquiry Card on page 229.

Frostrode Division of Viking Products, Vicksburg, Mich. These coolers are being placed on the market by the Progressive Welder Co., Detroit, Mich. An air-cooled refrigeration cycle is used in cooling the oil or other coolant. The flow circuit is designed to provide maximum heat transfer with minimum pressure drop or flow restriction. Coils are constructed of either steel or copper tubing.

The accompanying illustration shows a Micromatic Hydrohoner machine with a Frostrode fluid cooler for supplying the coolant to the honing tool at a preselected temperature. The coolant temperature is automatically maintained. The use of these coolers is said to result in higher production rates, closer tolerances on work-pieces; higher quality finish; decreased number of rejected parts due to variation in tolerances ordinarily caused by temperature change; increased tool life; and decreased tool maintenance cost. 66

Norton "Hyprolap" Vertical Lapping Machine Equipped for Continuous Finishing of Small Flat Parts

The Norton Co., Worcester, Mass., has adapted its No. 26 "Hyprolap" vertical lapping machine for the continuous finishing of small flat parts. This newly developed equipment has been designed to provide the following advantages: Automatic loading and unloading during the lapping cycle; continuous lapping with no "down time," except for dressing laps; high production without sacrifice of accuracy or finish; reduction of handling time to a minimum; operation by unskilled worker; use of simple work-holder which can be easily and economically replaced when required; and automatic safety device to stop machine if work is loaded improperly.

This machine is not designed to take the place of all existing lapping equipment, but is intended especially for use where the production requirements are unusually high. It is particularly adapted for the lapping of small flat washers and similar parts.

The illustrations show equipment furnished for continuous or through feed lapping of small brass washers. The unfinished parts are fed by a hopper which rotates and picks up the parts in slots that are so machined as to allow the parts to be seated with the raised surface down. The slots will also retain the parts if the raised surface is up, but through selective feed only those parts with the raised surface down are allowed to pass into the feeding trough spiraling from the upper part of the hopper, the others being returned to be fed again.

The selected washers fall down the loading chute to the finger loading mechanism shown in the close-up view, Fig. 2, which is designed to prevent ganging up of the parts and to guide each washer individually into the empty work-holder holes as they pass underneath the loading point. In the event that the parts double up or fail to load in the hole properly, a finger automatically actuates a

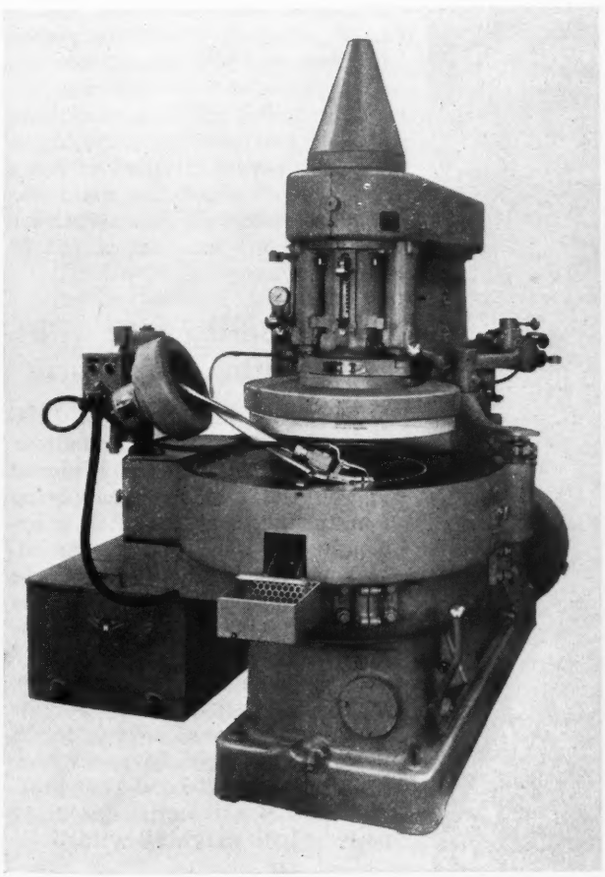


Fig. 1. Norton vertical lapping machine equipped for continuous finishing of small flat parts

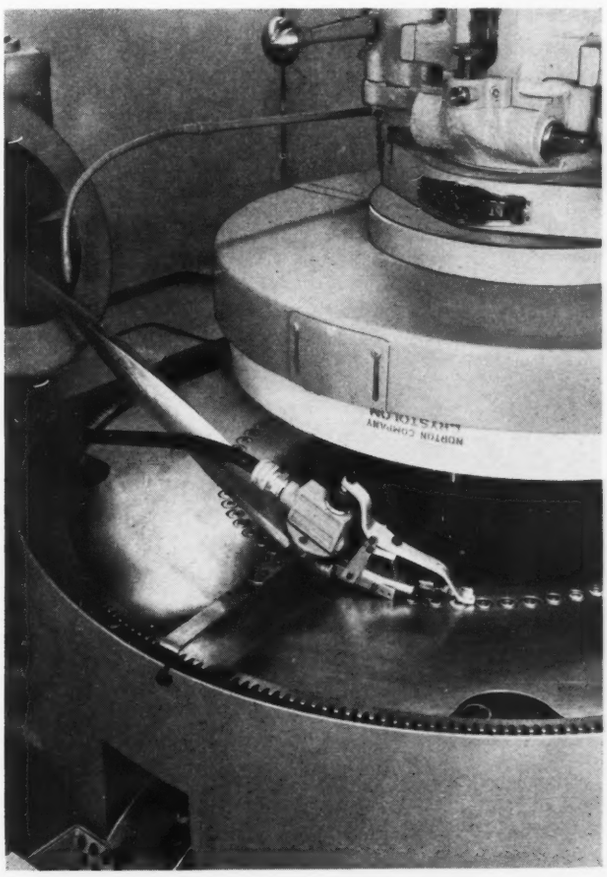
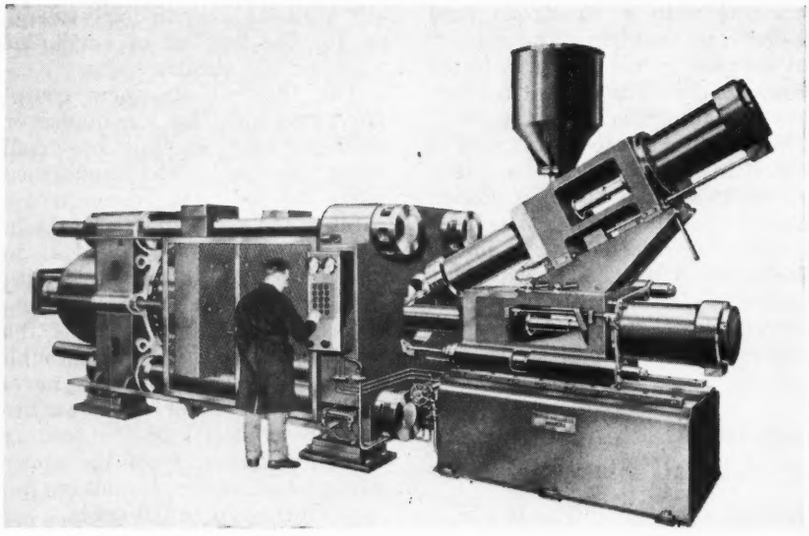


Fig. 2. Close-up view of automatic feeding device and safety stops of machine shown in Fig. 1

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Injection molding press of 300-ounce capacity built by Watson-Stillman Co.

safety device, shutting off the power and stopping the machine.

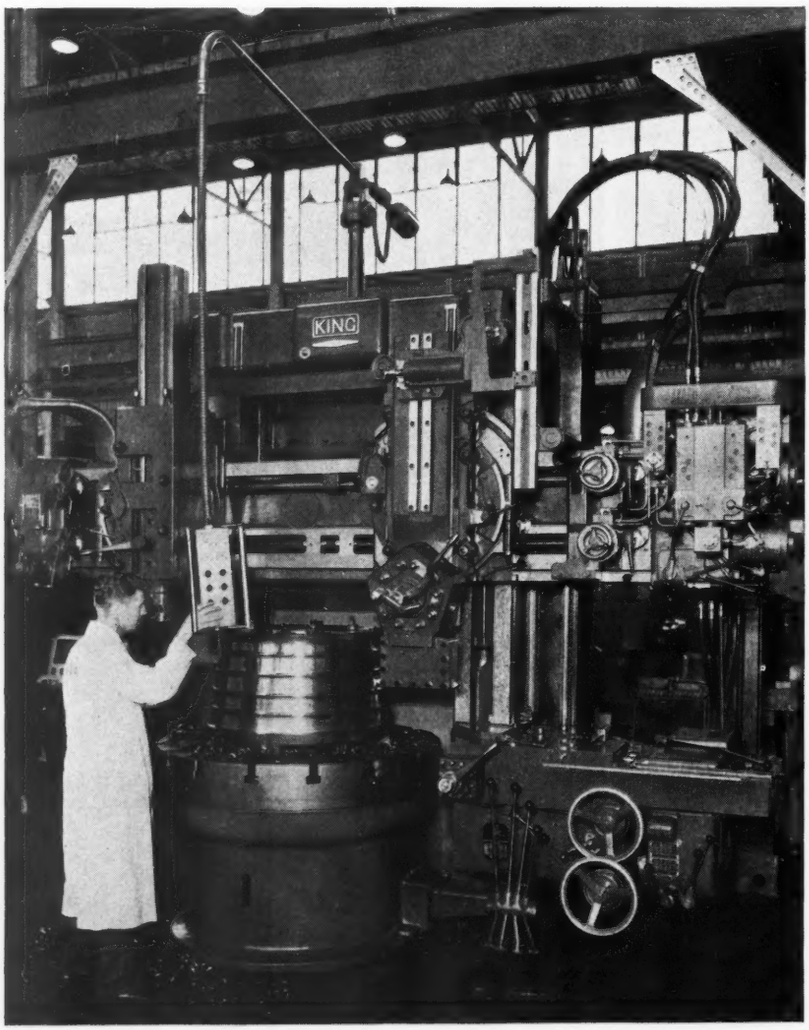
When loaded, the washers are directed between the rotating abrasive laps in a path that leads from the outer edge of the laps to the inner edge and out again. This allows for "break up," and results in uniform lap wear. After being lapped, the parts drop through an opening in the loading plate to the discharge trough. 67

Giant Size Injection Molding Machine

The Watson-Stillman Co., Roselle, N. J., has just announced the completion of what is said to be the largest injection molding machine ever built. This gigantic, 300-ounce capacity machine is fully hydraulic in operation. It is equipped with manual as well as automatic single-cycle control and adjustable speed control of the injection ram. Individual adjustable control of injection and clamping pressures is also provided.

Injection-molded plastic products of a size and weight exceeding anything which could be made with presses previously available can now be produced with this giant size press. Its 300-ounce per shot capacity, clamping pressure of 1500 tons, and platen which will accommodate a mold 4 feet by 6 feet make possible, for example, the injection molding of one-piece inner door liners and one-piece inner boxes for refrigerators. It also opens new possibilities in the production of plastic-molded television and radio cabinets, washing machine tubs, plumbing equipment, complete furniture pieces, luggage, and kitchen cabinets.

Machines of 300-ounce capacity, similar to the one illustrated, have already been built for the Amos Molded Plastics Division of Amos Thompson Corporation, and the General American Transportation Corporation. 68



Boring mill with contouring attachment designed for jet engine production

King Boring Mill with Contouring Attachment

The King Machine Tool Division, American Steel Foundries, Cincinnati, Ohio, has designed and built a 52-inch vertical boring and turning machine with a hydraulically controlled tracer attachment, which is said to be establishing new records for rapid production in a large jet engine plant.

In addition to the tracer attachment, this versatile machine is equipped with a swivel turret head and a special four-way toolblock on the left-hand ram head. It combines automatic contouring and manual roughing with auto-

To obtain additional information on equipment described here, use Inquiry Card on page 229.

matic depth control. By shifting one lever, the contouring attachment can be disconnected so that the machine can be used as a standard vertical boring mill.

This boring mill is of massive, rugged construction, with the extra weight and rigidity needed to assure dependable accuracy and maximum stock removal at the highest speeds within the range of modern cutting tools. All controls are conveniently located at the front of the machine and are easily accessible to the operator.

Other advantages claimed for this new vertical boring and turning machine include greater power and wider range of feeds and speeds. The complete line of machines of this type includes ten sizes ranging from 30 to 144 inches. 69

Tumbling Machine with Increased Capacity

A tumbling machine with increased capacity for grinding, deburring, and finishing metal parts has been brought out by the Grav-i-Flo Corporation, Sturgis, Mich. This machine is designed to use "Grav-i-Flo" chips and compounds to produce smooth and high luster surfaces. It is 5 feet 8 inches wide by 5 feet 4 inches deep by 5 feet 8 inches high. With its two 24-by 40-inch inside diameter compartments, it has exceptionally large load-handling capacity for the floor space occupied.

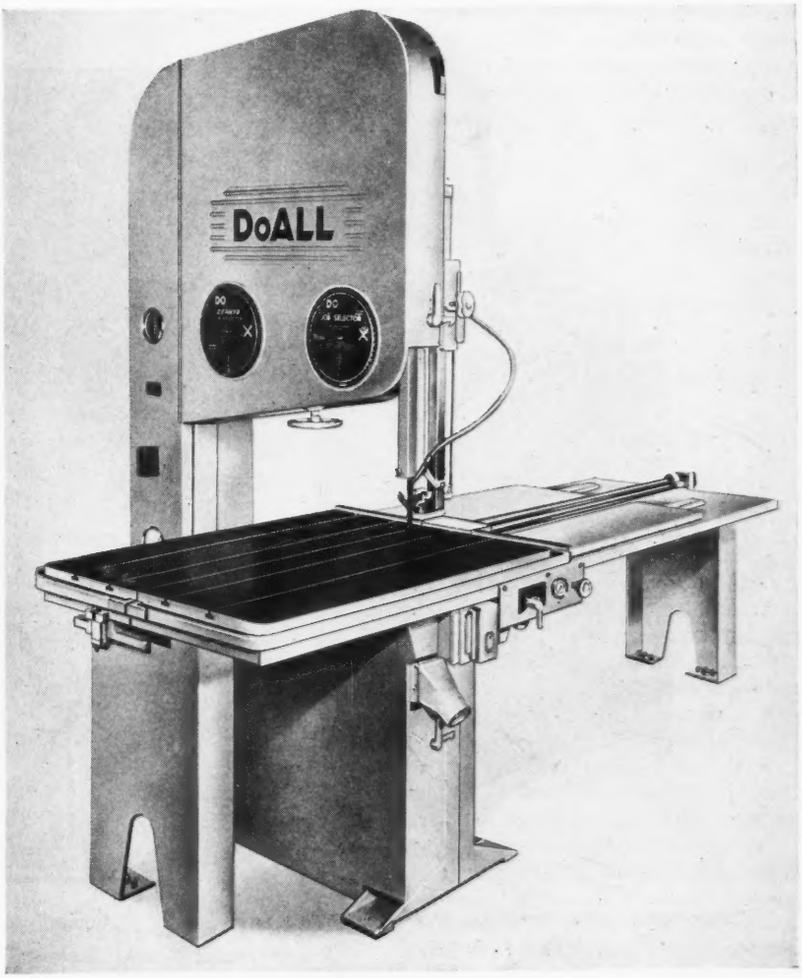
The tumbling compartments are furnished with 1/2-inch unlined plate or 1/4-inch rubber-lined plate. Doors have cam locks and manually released safety stops to provide pressure relief. 70

Grav-i-Flo tumbling machine with increased capacity

DoAll Hydro-Feed Band Saw

The DoAll Co., Des Plaines, Ill., has brought out a powerful new band-sawing machine, designated the HP-36 "Hydro-Feed," which has a throat capacity of 36 inches. This machine uses standard saw blades up to 1 inch in width. It is said to have a remarkable combination of power, speed range, hydraulic feeding capacity, and sawing versatility.

The machine is well guarded, and has automatic synchronized hydraulic aircraft type brakes. It is driven by a 10-H.P. motor, and has a three-speed transmission, as well as an overload-protected Speedmaster variable drive that gives a tool speed range of 40 to 10,000 feet per minute. The 40- by 48-inch T-slotted hydraulic



Hydro-Feed band saw of large capacity brought out by the DoAll Co.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

table slides on twenty-eight rollers distributed over a 36- by 87-inch bed, has a stroke of 36 inches, with 200 pounds hydraulic pressure available, and will support work weighing a ton or more.

Feed pressure is automatically controlled by the resistance of the work as the saw encounters changes in material thickness. The rate of in-feed is controlled up to 18 feet per minute, and there is a quick return movement. Other features include job selector dials and complete sets of guides for slow- and high-speed sawing, as well as band speed and tension indicating dials. The tool guide post is ground and counterbalanced for easy positioning, and has a large bearing area which provides rigid support. 71

Pratt & Whitney "Selectronic" Gage Designed to Classify Precision Parts

Pratt & Whitney Division Niles-Bement-Pond Co., West Hartford, Conn., has brought out an extremely accurate "Selectronic" gage designed to classify precision parts such as balls, rollers, pistons, and piston-pins according to critical tolerances. It is said to make possible broader production tolerances in the manufacture of such parts by providing a selective control for precision fitting at the time of assembly.

Carbon vanes for refrigerator compressor units, such as shown in the upper right-hand corner of the illustration, are an example of the kind of parts for which accurate interchangeable assemblies of minimum tolerances are demanded. Through the medium of Selectronic assembly, a vane thickness tolerance of 0.0032 inch is allowed, the gage automatically separating the vanes into thirty-two classifications varying by increments of 0.0001 inch.

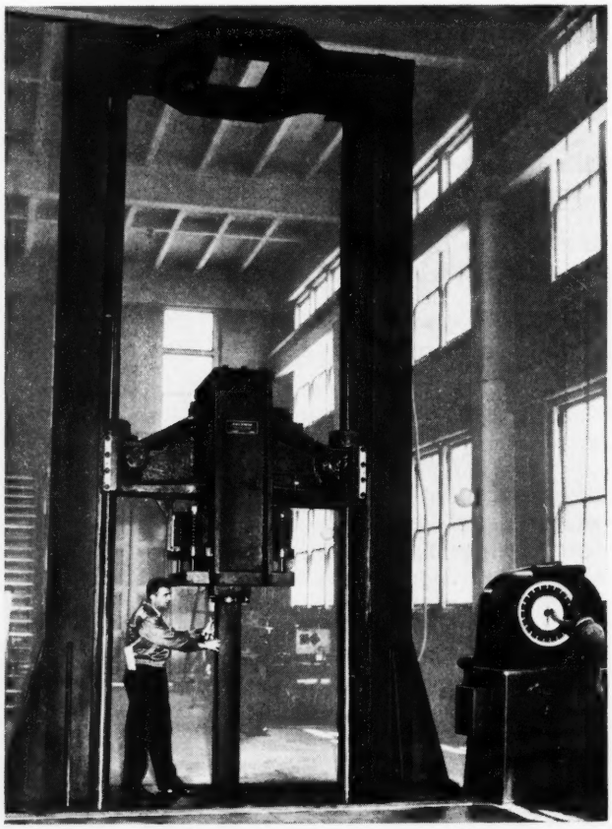
In this instance, the vanes are loaded into a magazine feeding mechanism, from which they are automatically fed under an "Electrolimit" gaging head and subsequently routed into the proper classification bin. The "Electrolimit" head operates a photo-electric control unit, which registers the size of the vane according to its thickness and directs it to the ejection chute and then to the classification bin.

As each piece is gaged, an electric impulse passes through a commutator having thirty-two size classification segments, and this actuates the chute positioning mechanism. Only one set of masters—a minimum and a maximum—is needed to adjust the gage. 72

Compression Testing Machine

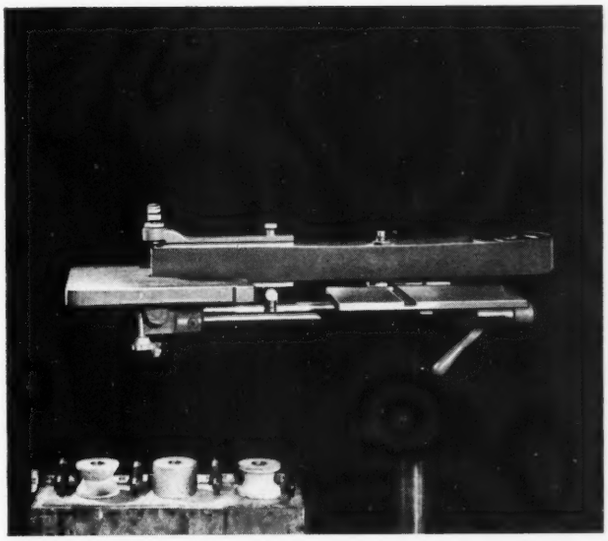
A 400,000-pound compression testing machine has been built recently by the Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa., and installed in the Materials Testing Laboratory of the University of Nebraska, Lincoln, Neb., where it will be used in classroom and research work. The machine is of welded construction, except for the cast-steel cross-head. It is 21 feet high, and weighs 75,000 pounds. The machine will accommodate test structures as large as 15 feet high and 6 feet wide. With suit-

"Selectronic" gage made by Pratt & Whitney to classify precision parts

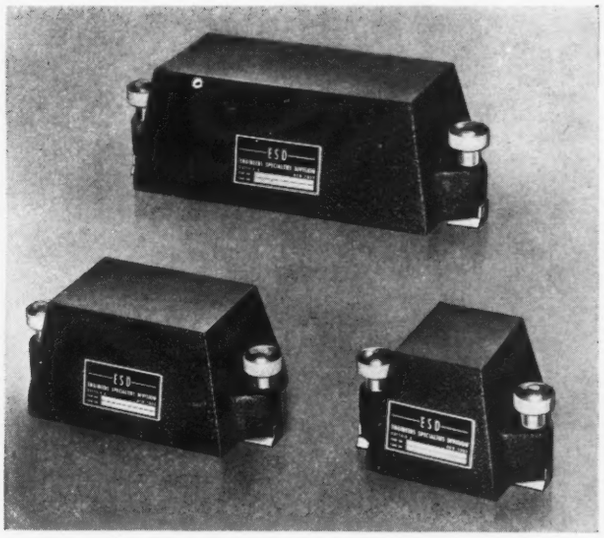


Compression testing machine built by Baldwin-Lima-Hamilton Corporation

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Drill press equipped with precision belt grinder made by George F. Grant Co.



Bases designed to simplify the mounting of holding fixtures on optical comparators

able framework supports, structures as high as 40 feet may be tested. In such tests, the allowable height of the structure is reduced by the height of the frame.

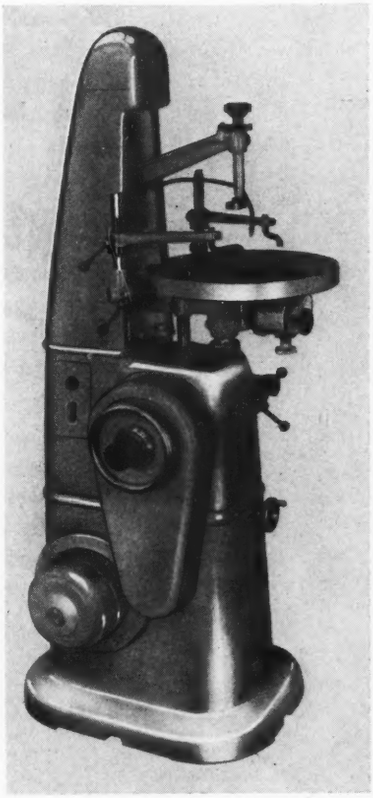
The loading cross-head is supported on two stationary vertical screws, and is raised and lowered to test positions at the rate of 11 inches per minute by means of two nuts that are rotated through worm-gears by a 7-H.P. electric motor on the cross-head. Compressive test loads are applied by a double-acting hydraulic ram on the cross-head, which has a 10-inch stroke, a loading speed of 0 to 3 1/2 inches per minute, and a fast return speed of 5 inches per minute. 73

Precision Belt Grinder Attachment for Drill Press

The George F. Grant Co., Inc., West Newton, Mass., has developed a precision belt contour grinder for use as an accessory to any drill press. This equipment can be easily mounted on a drill press column, and can be readily swung out of the way when not in use.

The grinder uses standard 2 1/2- by 60-inch abrasive belts. A simple device provides for the grinding of concave or convex parts and radii, as well as for deburring, shaping, and a wide range of other uses. Change of belt ratio or spindle gives speeds from 7000 to 36,000 R.P.M.

A special interchangeable spindle attachment is provided for continuous roll form or cylindrical grinding. The table can be moved to the rear of the driving pulley for exceptionally large work. Special equipment includes a spindle grinding attachment using 3/8- to 2-inch diameter abrasive sleeves for internal surfaces. 74



Williams punch and diemaking machine announced by the Connecticut Tool & Engineering Co.

Fixture Bases for Optical Projection Comparators

Improved bases have recently been developed by the Engineers Specialties Division, Universal Engraving & Colorplate Co., Inc., Buffalo, N. Y., for the special staging fixtures built by the company for use on American Optical projection comparators, Kodak contour projectors, and Jones & Lamson optical comparators. These fixture bases can be machined to accommodate various forms of holding fixtures and elements.

They are available in 2-, 4-, and 6-inch sizes, approximately 2 1/2 inches high, with ground top and bottom surfaces. Casehardened locking keys are made to fit the standard work-tables of the comparators. Knurled lock-screws on base insure positive locking. 75

Williams Punch and Diemaking Machine

The Connecticut Tool & Engineering Co., Bridgeport, Conn., has brought out a new Model F-3 Williams punch and diemaking machine designed to supersede the previous model. This machine is designed to facilitate final finishing operations on metal stamping or power press punches and dies for the extrusion of metals. The accompanying illustration shows the machine equipped with a 1/2-H.P., 1800 R.P.M., axial air-gap motor, but the flange on the base is designed to take other standard horizontal shaft motors.

To obtain additional information on equipment described here, use Inquiry Card on page 229.

The NEW Brown & Sharpe MICROMETERS

NEW! Larger diameter thimble

NEW! Stainless Steel, one-piece spindle and screw

NEW! Exclusive adjustments . . . easy, quick, accurate

NEW! Carbide measuring faces

- Black graduations
- Dull chrome finish
- Wide divisions
- Hardened and ground threads
- New sliding taper thread adjustment
- Positively locked screw and thimble
- Quick, easy thimble adjustment
- Rust resistant
- Available in complete range of sizes

Cutaway view shows exclusive Brown & Sharpe adjustments—simple, positive, accurate.

Large diameter thimble provides wide divisions. Easy-reading black graduations and figures on rust-resistant dull chrome finish.

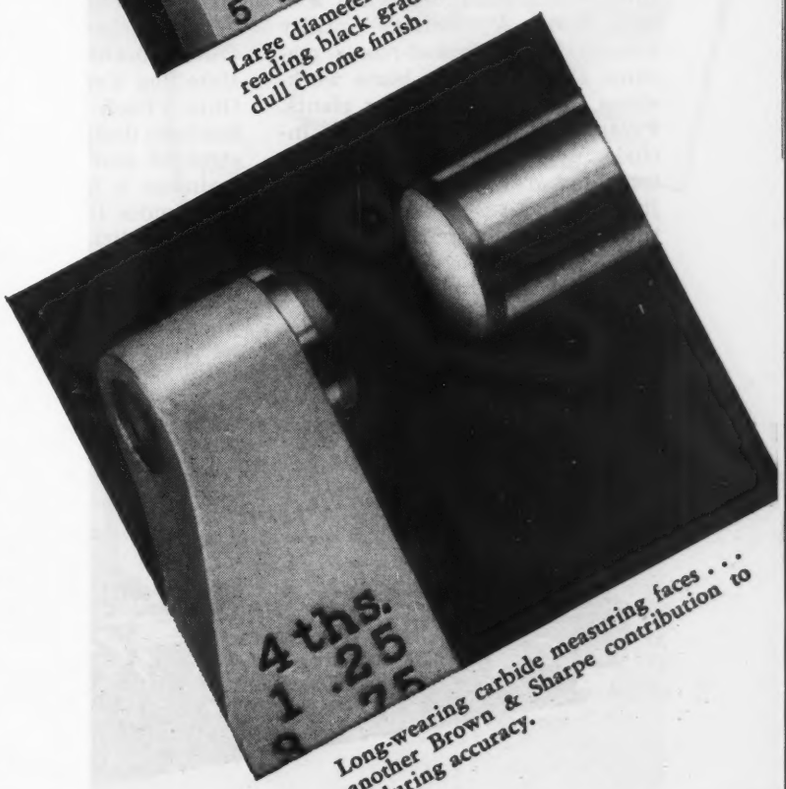
An exclusive combination of advanced features!

Never before has a line of micrometers offered such an outstanding combination of advanced features! Improvements throughout the new Brown & Sharpe Micrometers now contribute higher performance to every essential of micrometer service . . . readability, accuracy, ease of adjustment, durability.

Notice the widely-spaced divisions, black graduations and dull chrome finish . . . for easy, accurate reading. Observe the integral spindle and screw with simplified thread adjustment and longitudinal adjustment of thimble on screw. Consider what the long-wearing carbide faces and one-piece stainless steel spindle and screw with hardened and ground threads mean to durability!

Only by actually seeing and holding one of these new micrometers in your own hand can you appreciate all the advantages of these many new features. See them at your hardware store or tool supplier's. Write for illustrated folder describing the completely new line of Brown & Sharpe Micrometers. Brown & Sharpe Mfg. Co., Providence 1, R.I., U.S.A.

We urge buying through the Distributor



Long-wearing carbide measuring faces . . . another Brown & Sharpe contribution to enduring accuracy.

Brown & Sharpe

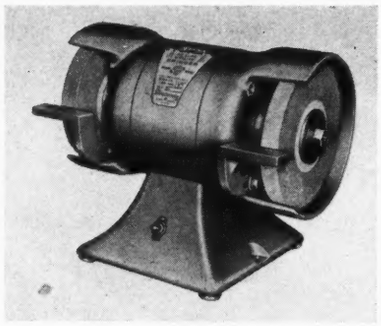
B·S

The variable-speed transmission is fully enclosed and is operated from a conveniently placed dial and handle. It provides speeds of 75 to 350 strokes per minute for the operating shafts, as required for various grades of steel. The new main-drive mechanism has a segment and gear control and a throw-out clutch which facilitate stroke adjustment. A splash lubricating system is provided for the drive mechanism to insure quiet operation and obtain a cushioning effect for the reciprocating frames.

The machine has a compound tilting table with a vernier scale; 5-inch stroke and table adjustment; heavy 17-inch diameter counterbalanced table; air pump and pipe; adjustable lights; attachments for light and heavy compression and tension files; holders and guides for fine or jeweler's saws; and honing or stoning adapters. The machine weighs 1800 pounds. 76

Lima "DeLuxe" Utility Grinder

The Lima Electric Motor Co., Lima, Ohio, has brought out a 6-inch Model A "DeLuxe" utility grinder for use in tool-rooms, machine shops, schools, home workshops, and manufacturing plants. Features of this new grinder include dynamically balanced rotors; integral wheel guards; adjustable tool-rests, which can be tilted for angular grinding; heavy-duty, "off-on" toggle switch in base; and cast-iron base, rubber-



"DeLuxe" utility grinder made by Lima Electric Motor Co.

mounted and drilled for permanent mounting.

The grinder is equipped with a 1/4-H.P., 3450-R.P.M. motor that operates on single-phase, 60-cycle, 115- or 230-volt alternating current. It is furnished with two grinding wheels, one coarse and one fine grit, each 6 inches in diameter with a 3/4-inch face. 77

Niles Heavy-Duty Engine Lathes of Improved Design

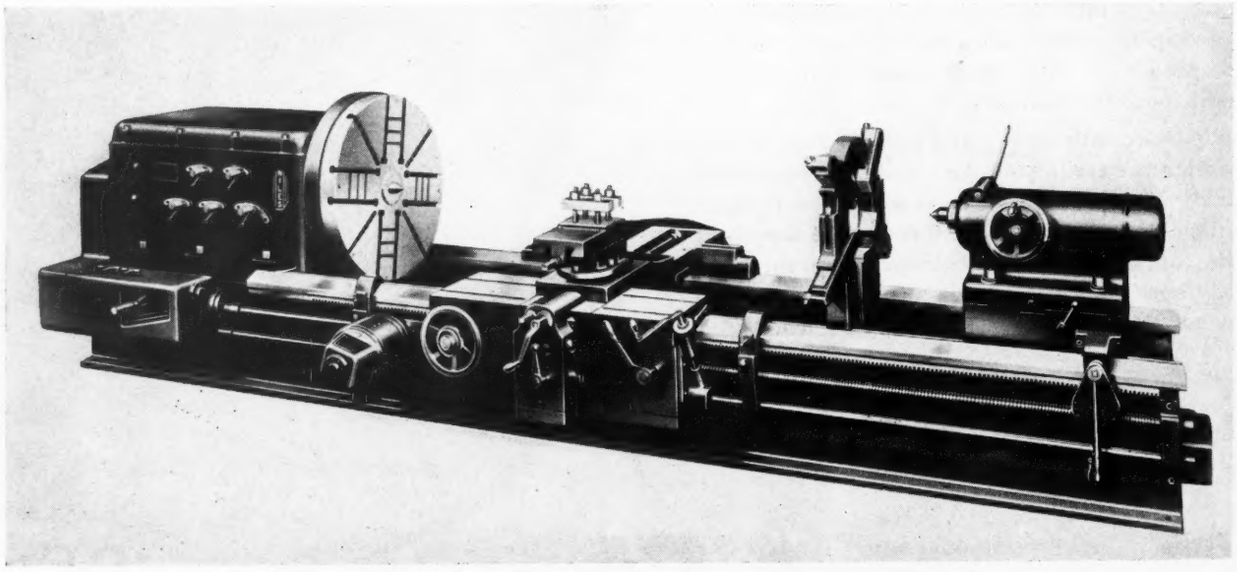
A new line of Niles heavy-duty engine lathes, ranging in size from 40 to 80 inches and up, has been introduced by the Niles Tool Works Co. Division, Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio. Each unit of these lathes has been designed with the reserve strength and rigidity required to maintain a high degree of accuracy under the most severe operating conditions. The lathes are powered by either alternating- or direct-current motors. Fifty-six feeds for turning and thread-cutting are available through a quick-change feed-box without changing gears in the enclosed quadrant located at the end of the bed.

The 40-inch engine lathe is of ribbed semi-steel construction with a 24-inch deep bed designed to prevent twisting and horizontal or vertical deflection, yet maintain the spindle centers at eye level. The bed is 40 inches wide and provides ample support for the tool and does not overhang when turning work of any size up to the maximum capacity of the lathe.

Both power and hand longitudinal, cross, and angular feeds are provided for the carriage and the compound rest which supports the tool-block. A fine-toothed clutch, which can be easily snapped in and out, engages the carriage feeds. Hand adjusting screws with micrometer dials permit accurate positioning of the tool. A 1 1/2-H.P. motor, mounted on the apron, permits longitudinal traverse without the danger of a rapidly revolving lead-screw.

The lathe headstock is completely enclosed and has a length on the bed of 50 1/2 inches. All shafts, including the large-diameter spindle, are mounted in anti-friction bearings. Easily operated gear-change levers permit quick selection of speeds high enough for tungsten-carbide tools or low enough for very heavy cuts. The tailstock spindle is 6 1/2 inches in diameter and has a travel of 12 inches.

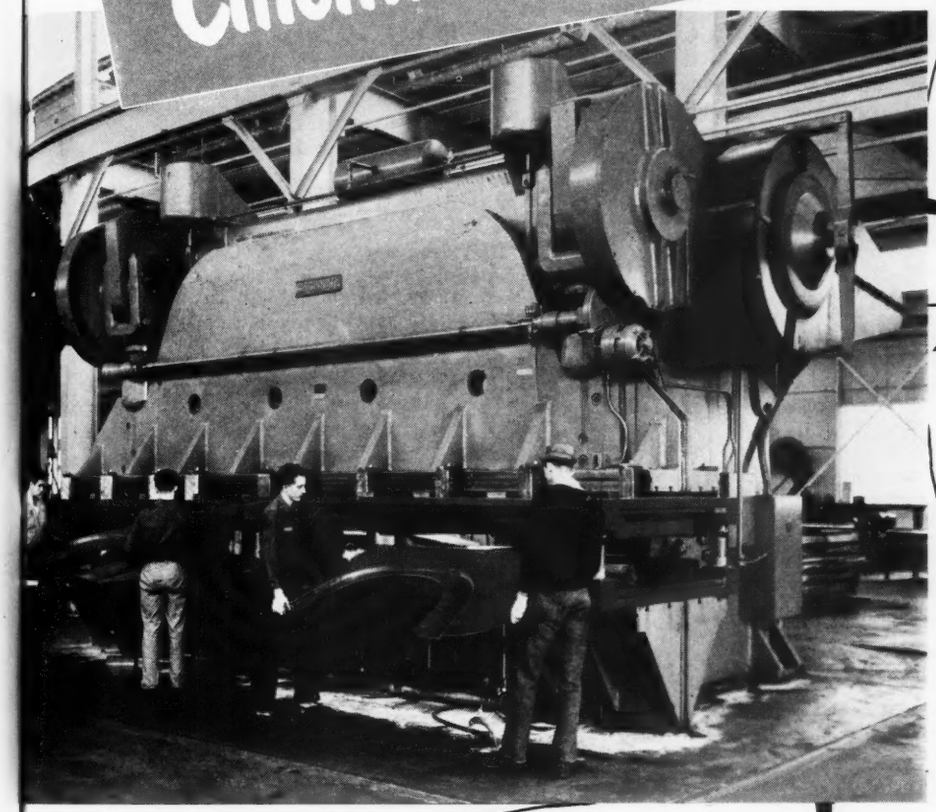
The drive for the 40-inch lathe

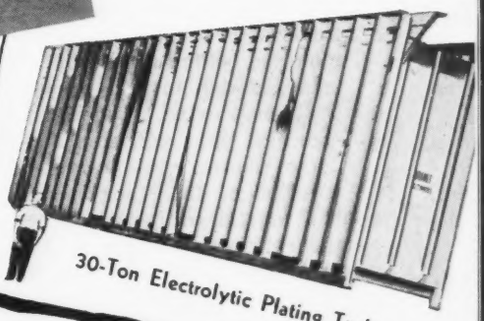


Heavy-duty engine lathe of new line built by Niles Tool Works Co. Division, Baldwin-Lima-Hamilton Corporation

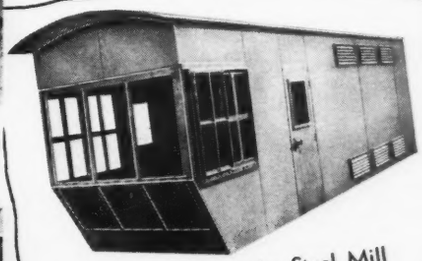
To obtain additional information on equipment described here, use Inquiry Card on page 229.

DO IT ON A VERSATILE Cincinnati Press Brake

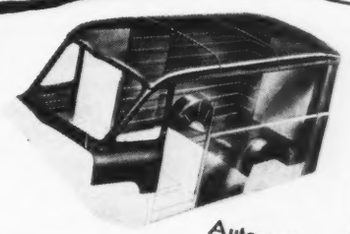




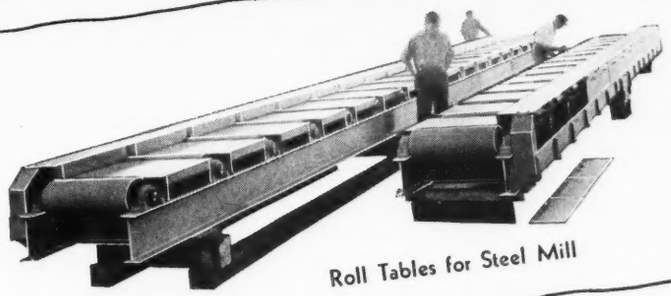
30-Ton Electrolytic Plating Tank



Control House for Steel Mill

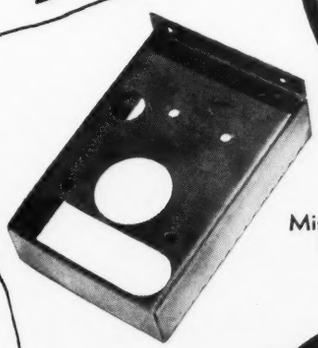


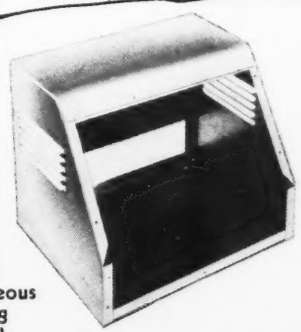
Automotive Products



Roll Tables for Steel Mill

Illustrations courtesy of Charles T. Brandt, Inc.





Miscellaneous Forming

The press brake capacity of Charles T. Brandt, Inc., adequately takes care of the job, whether large or small—in jobbing or production quantities.

In a highly competitive field, the powerful and versatile Cincinnati Press Brakes are profitable performers. They not only meet competition—they set the pace.

Write for catalog B-2A, describing operations, features, and special arrangements including wide beds and rams, bed and ram extensions, deeper gaps, higher die space and other features.

THE CINCINNATI SHAPER CO.

CINCINNATI 25, OHIO, U.S.A.

SHAPERS · SHEARS · BRAKES

CINCINNATI

is furnished by a 40-H.P. constant-speed alternating-current motor or a 3 to 1 speed ratio direct-current motor. The motor is floor mounted behind the headstock and is adjustable to take up slack in the V-belt drive. Controls on the carriage start and stop the main drive motor, set the directional rotation of the spindle, and control the traversing movements of the carriage. Pump motors are controlled by push-buttons mounted on the headstock, and additional buttons also provide a jogging motion to facilitate shifting the speed change-gears. 78

Electric Remote Control for Sterling "Speed-Trol"

An electric remote control is now available for the "Speed-Trol" variable-speed electric power drives made by Sterling Electric Motors, Inc., Los Angeles, Calif. This unit control can be easily mounted on any size "Speed-Trol" now in use, and it can be supplied with all new "Speed-Trols." The complete unit includes a mounting bracket, reversing motor, chain and sprockets, friction clutch, chain guard, and remote "Fast-Slow" station. It can be supplied either with or without an electric remote speed indicator.

"Speed-Trol" electric power drives with the new automatic remote control can now be obtained in ratings of 1/2 to 25 H.P., inclusive, and are manufactured in speed ratios of 2 to 1, 3 to 1, or 4 to 1, with a speed range from 2000 down to 26 R.P.M. Positive adjustment of the "Speed-Trol" pulleys provides infinite speed variation and a steady flow of power at any selected speed. 79

Wales Multiple-Hole Punching Equipment

A new multiple-hole punching system has been announced by the Wales-Strippit Corporation, North Tonawanda, N. Y. The assembled and disassembled punch and die units of the system are shown in Fig. 1. This equipment provides a simpler, faster, and more economical method of punching holes in sheet-metal parts by permitting the entire set-up to be made outside the stamping press or press brake. The punch and die units are interchangeable, so that the same units can be used and reused in an infinite number of set-ups.

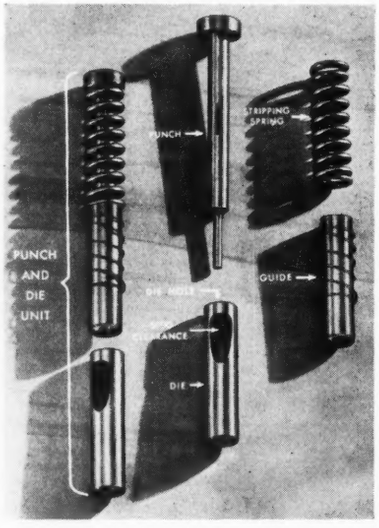


Fig. 1. Wales punch and die units shown assembled and disassembled

The punch and die units are used with the Wales box type set-up shown in Fig. 2 or with a twin plate arrangement. The box type assemblies are suitable for punching small parts—up to 21 by 23 inches—while the twin-plate assemblies are adapted for punching parts up to 44 by 92 inches.

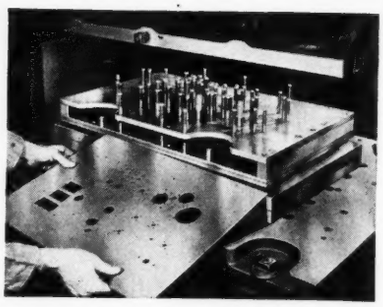


Fig. 2. Wales box type set-up, using punch and die units shown in Fig. 1

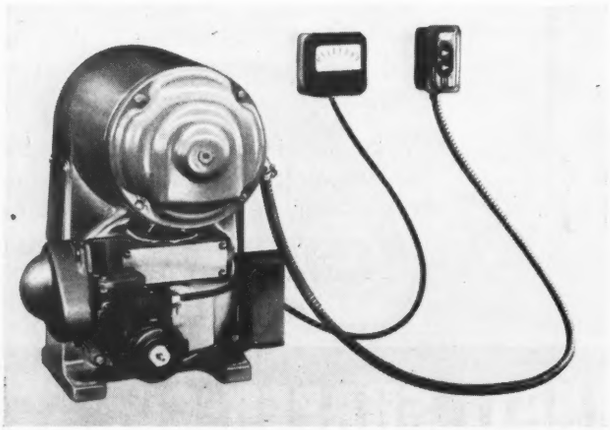
Holes for the punch and die units are located and drilled in both the box type and twin-plate set-ups with a master templet as a pattern. They can be located over the entire working area of the set-up in any direction. The punches are inserted in the top plate, and the dies in the bottom plate. All that is required is a different box or set of plates for each hole punching pattern.

When a production run is completed, the punch and die units are simply removed for use in other set-ups, and the drilled boxes and twin plates stored for future use.

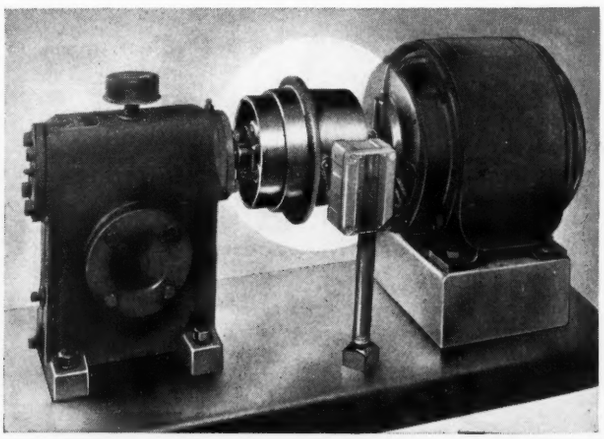
The self-contained box type set-ups are simply placed on the press bed, while the twin-plate set-ups have the punch plate fastened to the press ram and the die plate bolted to the bed. 80

Anchor Cut-Out Couplings

A new automatic cut-out coupling for machine tool drives, processing equipment, conveyors, etc.,



"Speed-Trol" variable-speed electric power drive with automatic remote control made by Sterling Electric Motors

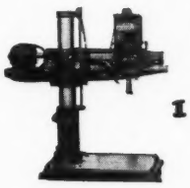


Motor drive with Anchor automatic cut-out coupling which instantly shuts off motor when overload occurs

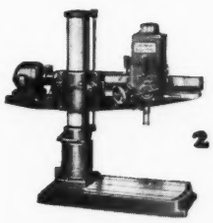
To obtain additional information on equipment described here, use Inquiry Card on page 229.

Which SUPER SERVICE will suit your JOB?

For greatest savings in drilling cost The Cincinnati Bickford Tool Company offers a complete line of 34 different sizes and types of drilling machines. One of these machines will cut your drilling costs more efficiently. Our engineers will help you select the proper machine for your work, or if you prefer, send for any or all of the bulletins pertaining to the machines that interest you.

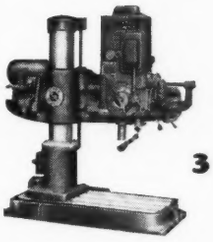


1. The smallest SUPER SERVICE Radial Drill manufactured by The Cincinnati Bickford Tool Company, as described in Bulletin R-26A, has a 7½" diameter column and a 2½' arm length. This machine is furnished with 6 speeds and 3 feeds and a 1 HP driving motor.

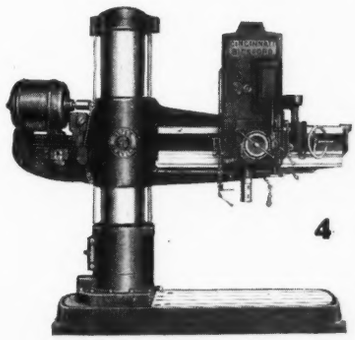


2. The 9" Diameter Column SUPER SERVICE Radial Drill, as described in Circular R-21B, is built in either a 3' or 4' arm length with 9 speeds and 4 feeds powered with a 3 HP driving motor.

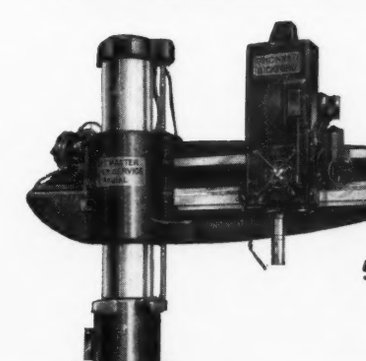
3. SUPER SERVICE Radial with 11" dia. column is described in Bulletin R-29. Built with a 3', 4' or 5' arm. 12 speeds and 6 feeds or 36 speeds and 18 feeds furnished. Powered with either a 5 or 7½ HP driving motor.



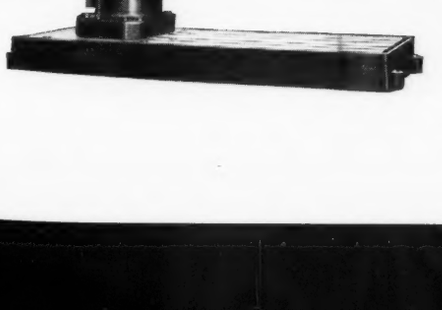
4. The 36-speed 18-feed SUPER SERVICE Radial Drill, as described in Booklet R-29, is furnished in 11 different standard sizes, ranging from 4' to 8' arm lengths and 13" to 19" diameter columns. These machines are furnished with 7½ to 20 HP driving motors.



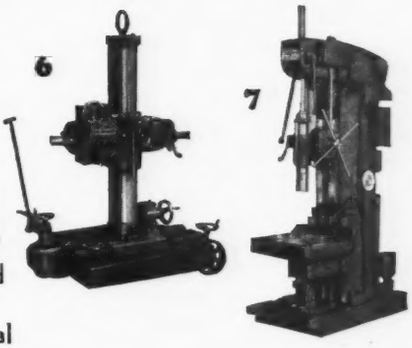
5. The SUPER SERVICE Master Radial Drill, as described in Circular R-22, is built in 7' to 12' arm lengths and in 22" and 26" diameter columns. This machine has 36 speeds and 18 feeds powered by motors from 20 to 40 HP.



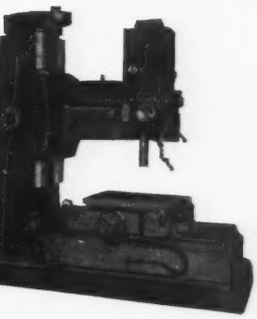
6. The SUPER SERVICE Portable Horizontal Drilling Machine with 6 power feeds and 1½ HP driving motor is more fully described in Bulletin HR.



7. The SUPER SERVICE High Production Manufacturing Type Uprights have many of the advantages of the general purpose drilling machines but, due to their simplified construction, they are much more economical. They are furnished in 21", 24" and 28" sizes with 3, 5, 7½ or 10 HP driving motors. Booklet U-27 will furnish you more complete details.

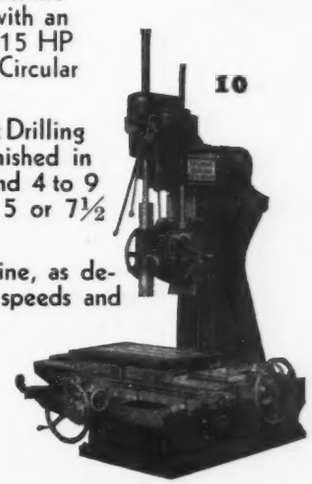


8. The new SUPER SERVICE Precision Drilling Machine is especially suited to operations in conjunction with an automatic spacing table. This 36-speed 18-feed 15 HP motor machine is more completely described in Circular FH.



9. The SUPER SERVICE General Purpose Upright Drilling Machines, as described in Booklet U-25, are furnished in 21", 24" and 28" sizes. From 9 to 12 speeds and 4 to 9 feeds. The machines are powered by either 3, 5 or 7½ HP motors.

10. The SUPER SERVICE Jig Boring Machine, as described in Bulletin U-26B, is furnished in 12 speeds and 9 feeds with a 3 HP driving motor.



Equal Efficiency of Every Unit Makes the Balanced Machine

SUPER CB SERVICE

THE CINCINNATI BICKFORD TOOL CO.

Oakley Cincinnati 9, Ohio, U. S. A.

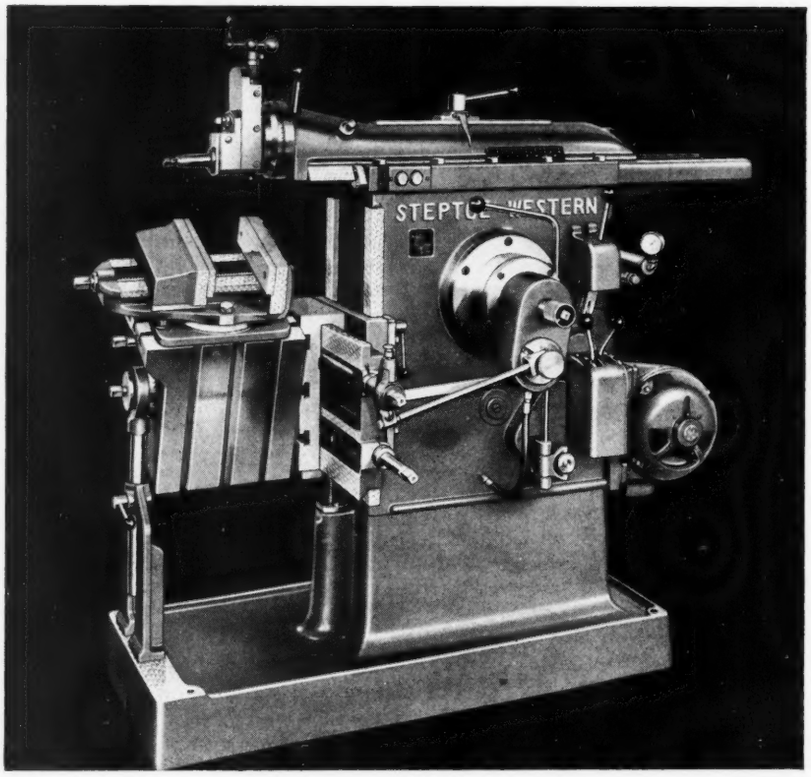
which instantly shuts off the power when an overload occurs and resets itself automatically has been announced by the Anchor Steel & Conveyor Co., Dearborn, Mich. This device eliminates the necessity for using shear pins, and saves the time normally required to replace them. It combines the features of a flexible coupling with the torque-sensitive protection of the Anchor cut-out pulley. The cut-out coupling is furnished in two sizes, with working ranges from 20 to 10,000 inch-pounds torque. ----------81

Steptoe-Western Shapers

The Western Machine Tool Works, Holland, Mich., has announced a new shaper which is being built in two models—a four-speed and a nine- or eighteen-speed machine. Both models are available in 12- and 15-inch sizes. All have Timken bearings, V-type rams, and centralized controls. A plain table and a 10-inch heavy-duty vise with swiveling base graduated to 180 degrees are standard equipment on these shapers. Also available is a universal revolving table which can be rotated on a heavy trunnion through 45 degrees each side of the center position. When required, a tilting table top supplementary to the regular table can be supplied for compound-angle work.

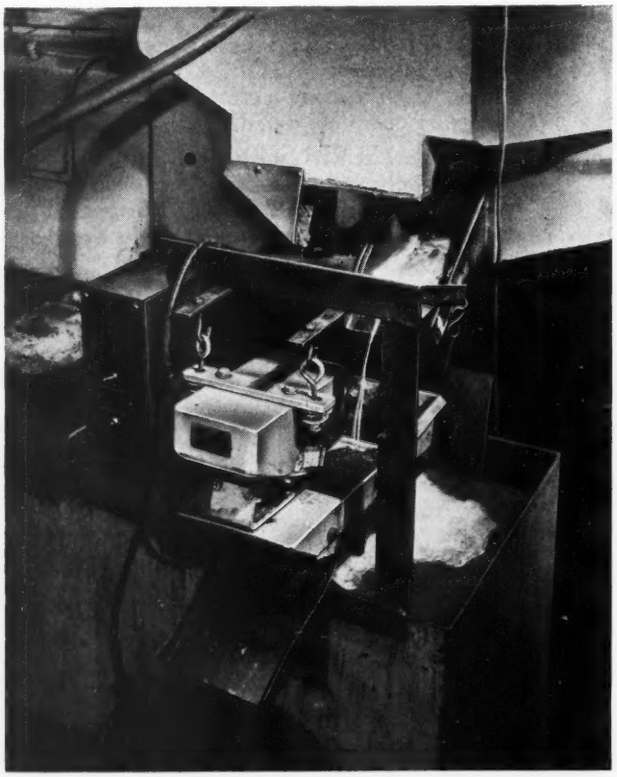
The eighteen-speed shaper has a standard range of 17 to 200 strokes per minute or an optional range of 13 to 150 strokes per minute. The nine-speed shaper has a standard range of 30 to 105 strokes per minute or an optional range of 24 to 80 strokes per minute. All shapers in the new line have eight feeds in either direction with a range of 0.006 to 0.053 inch per stroke. The four-speed model has speeds of 27, 48, 80, and 130 strokes per minute.

The 12-inch shapers have a maximum stroke length of 12 3/4 inches, and the 15-inch shapers a maximum stroke length of 15 3/4 inches. All machines have a vertical-head travel of 6 inches, a horizontal table travel of 19 1/2 inches, and a vertical table travel of 12 1/4 inches. The tables are 16 1/8 inches long, 9 7/8 inches wide, and 13 3/4 inches deep.



Steptoe-Western high-speed type shaper

The drive is through three V-belts, a 2- or 3-H.P., 1800-R.P.M. motor being recommended for the 12-inch shapers, and a 3-H.P., 1800-R.P.M. motor for the 15-inch size. Both sizes of these shapers require a floor space 34 inches wide by 58 inches long. The smaller machine weighs about 2150 pounds, and the larger about 2250 pounds. ---------- 82

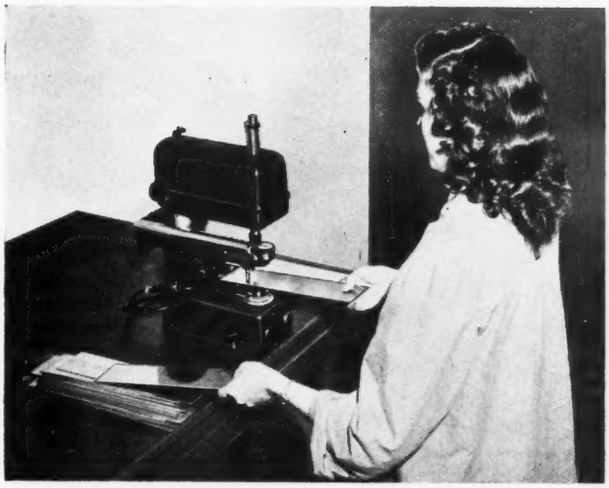


Screening Feeder for Desludging Coolant

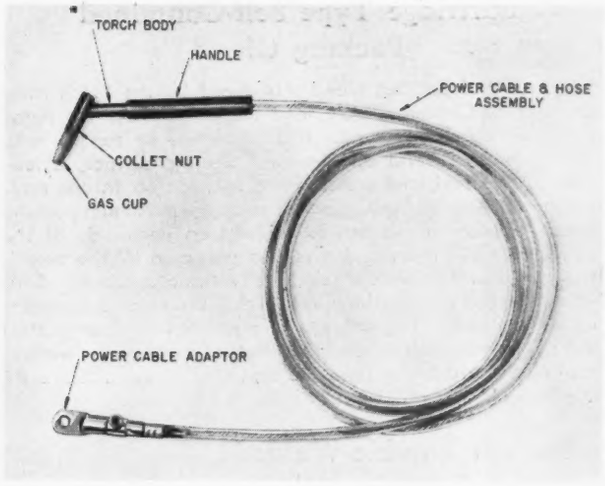
The Syntron Co., Homer City, Pa., has recently added a new model vibratory screening feeder to its line of feeding equipment. This device was developed to eliminate the trouble experienced from steel filings and abrasive grains filling up the coolant tanks of grinding machines.

Syntron vibratory screening feeder applied to a grinding machine for desludging coolant

To obtain additional information on equipment described here, use Inquiry Card on page 229.



Topflight automatic certifying hardness tester for sheet-metal parts



"Heliarc" light-weight welding torch made by The Linde Air Products Co.

The used coolant from the machine tool is run through the vibrating screen, which catches the steel filings and abrasive grains and feeds them as sludge into a receptacle, clean coolant being returned to the storage tank for further use. This screening feeder is said to have effected quite a saving in time by eliminating a thirty-minute period at the end of each shift, previously required for cleaning out the coolant tank. 83

Hardness Tester and Certifier

A newly designed automatic certifying hardness tester for sheet-metal parts has been placed on the market by the Topflight Tool Co., Inc., York, Pa. This instrument is especially adapted for testing the new hard aluminum alloys specified for use in the aircraft industries. In operation, an impressor needle moves up and down on an anvil. The pieces to be inspected are fed between the needle and the anvil, and when the point comes in contact with the part, a dial reading is visible and a green light flashes if the piece is of the required hardness.

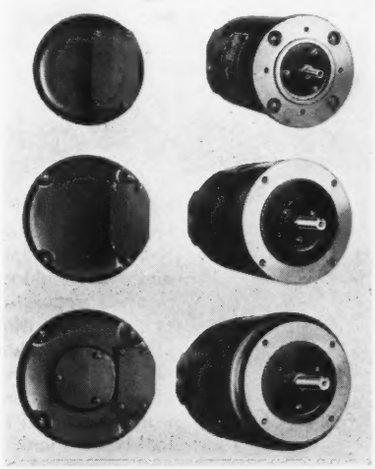
A stamp then automatically applies a certifying mark and a counting device registers the total pieces inspected. When a metal part is not of the required hardness, the green light will not flash, the stamping die will not function, and the counter will not register.

The whole operation of testing and certifying is automatic, except feeding of the parts. 84

Doerr Motors with New Face Mountings

The illustration shows the standardized line of 42, 56, and 66 fractional-horsepower frame series Doerr motors with new NEMA Type C face mountings, manufactured by Electro Machines, Inc., Cedarburg, Wis. The front view of each shows the streamline, built-in conduit box provided on all three frame sizes. This box was designed to provide adequate room for making the connections for nine-lead dual-voltage motors normally used as standard equipment on coolant pumps and other machine tool applications.

The conduit opening can be furnished with either a 7/8-inch plain hole or a 1/2-inch pipe-tap hole. Bolted-on removable bases are available. 85



Doerr fractional-horsepower motors made by Electro Machines, Inc.

Linde Light-Weight "Heliarc" Torch

The Linde Air Products Co., Unit of Union Carbide and Carbon Corporation, New York City, has brought out a new, lightweight, air-cooled "Heliarc" torch for inert gas-shielded arc welding. The torch has a two-position welding head, does not require water cooling, has a maximum capacity of 75 amperes for continuous duty, and is designed for welding thin-gage materials.

The head and handle assembly of the new HW-9 torch weighs only 5 ounces. In normal welding operations, the torch head is held at a 120-degree downward angle from the handle, as shown in the illustration. By interchanging the collet nut and torch cap, the torch head can be changed to a 60-degree angle sloping backward from the handle. This permits making welds in inaccessible spots.

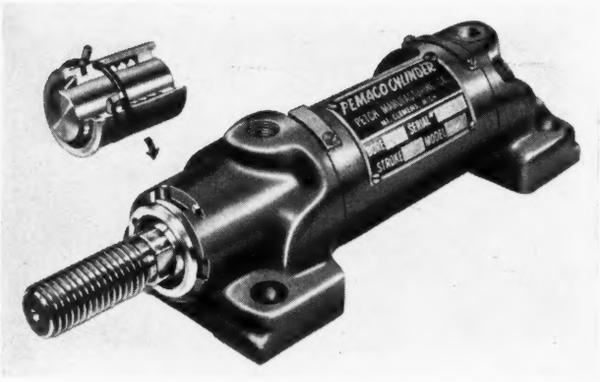
The collet nut is part of the torch body. A quarter turn of the nut frees the electrode from the two-piece quick-release type electrode-holder. Steel collets are available for electrodes of 0.020, 0.040, and 1/16 inch diameter. All three sizes of collets can be used with this collet nut. Two torch caps are available, permitting the use of 3- or 7-inch electrodes.

The entire torch body is sheathed in nylon plastic to safeguard the operator from electrical shock, and the collet nut is insulated with a molded plastic shield. The torch can be used with either straight-polarity direct current or high-frequency stabilized alternating current. 86

To obtain additional information on equipment described here, use Inquiry Card on page 229.

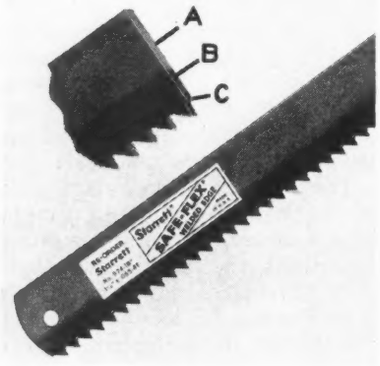
Cartridge Type Self-Contained Packing Gland

Self-contained packing gland introduced by the Petch Mfg. Co., Mount Clemens, Mich., and marketed under the name Pemaco "E-Z-Pak" gland. It is designed to comply with J.I.C. standards, and combines the bearing surface, a low-friction ram seal, and a seal guard ram scraper in one compact unit. Ample bearing surface to insure maximum packing life is provided by a bronze bushing on each side of the packing rings. The packing is also protected by the bronze seal guard scraper, which excludes all external abrasives. Self-adjusting metallic packing eliminates need for adjustment after installation. Replacement of gland can be accomplished without dismantling the cylinder and, in most cases, without removing the cylinder from the machine. 87



Starrett Double-Welded Power Hacksaw Blades

Power hacksaw blade of unique construction designed to combine hardness with toughness for safe, shatterproof, high-speed production cutting. A hard, high-speed steel cutting edge (C) is integrally welded to a medium hard, extra strong steel center (B) which, in turn, is welded to a super-tough steel back (A), resulting in an extremely strong blade adapted for fast, sustained cutting of tough materials. The new blade, called the "Safe-Flex," is made in all standard power hacksaw sizes by L. S. Starrett Co., Athol, Mass...88

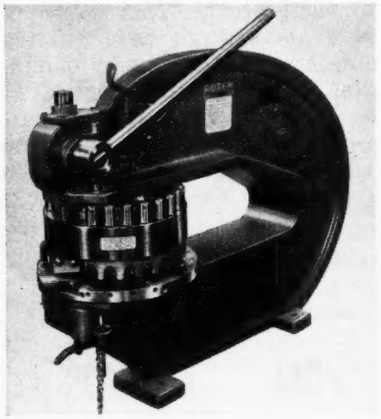


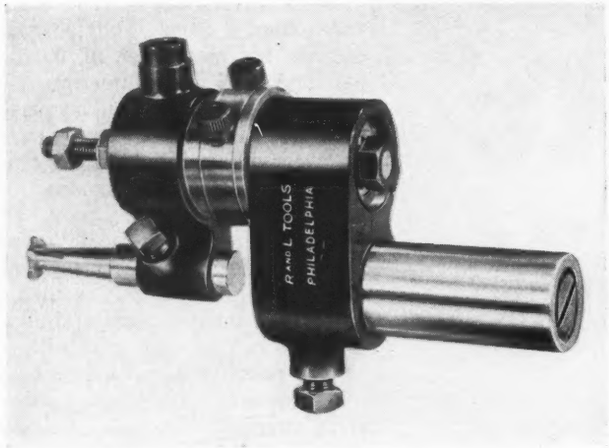
Bi-Colored Lenses for Heat-Treaters' Goggles

The bi-colored fused lenses shown in the illustration are designed to protect the eyes of workers engaged in heat-treating, furnace operations, and welding. The new lenses can be fitted in the goggle frames in a fraction of the time required for the older half-lenses. They are made to fit spectacle or cup type goggles in regular and six-curve, round, and FV3 shapes. Available in various glass combinations. Product of the American Optical Co., Southbridge, Mass. 89

Rotex Punch Press Designed to Handle Wide Sheets

Punch press with 24-inch throat designed to handle sheet material up to 48 inches wide. The rotary turret of this punch press permits the operator to quickly locate any one of eighteen different size punches in the operating position. The punch sizes range from 5/64 inch to 2 inches in diameter for operating on cardboard, fiberboard, plastic, or sheet iron in thicknesses up to 10 gage. Brought out by the Rotex Punch Co., Oakland, Calif.....90





R & L New Design, Adjustable Recessing Tool

Recessing tool of new design which can be adjusted to operate on any internal diameter within the capacity of the machine. Recently developed by R & L Tools, Philadelphia, Pa. This new recessing tool can also be adjusted for cutting grooves or similar operations, such as chamfering or cutting clearance at the end of threads on outside-diameter work. Two screws provide for making fine adjustments for depth or diameter of recess. It can be used with the machine spindle running in either direction, or so that pressure on the cutter is downward. This tool is now available in three sizes: The No. 00 tool has a shank 1 1/2 inches long and 5/8 inch in diameter and a body 1 3/4 inches long; the No. 1 has a shank 2 inches long by 3/4 inch in diameter and a body 2 inches in length; the No. 2 has a shank 2 inches long by 1 inch in diameter and a body length of 2 3/4 inches. 91

To obtain additional information on equipment described here, use Inquiry Card on page 229.

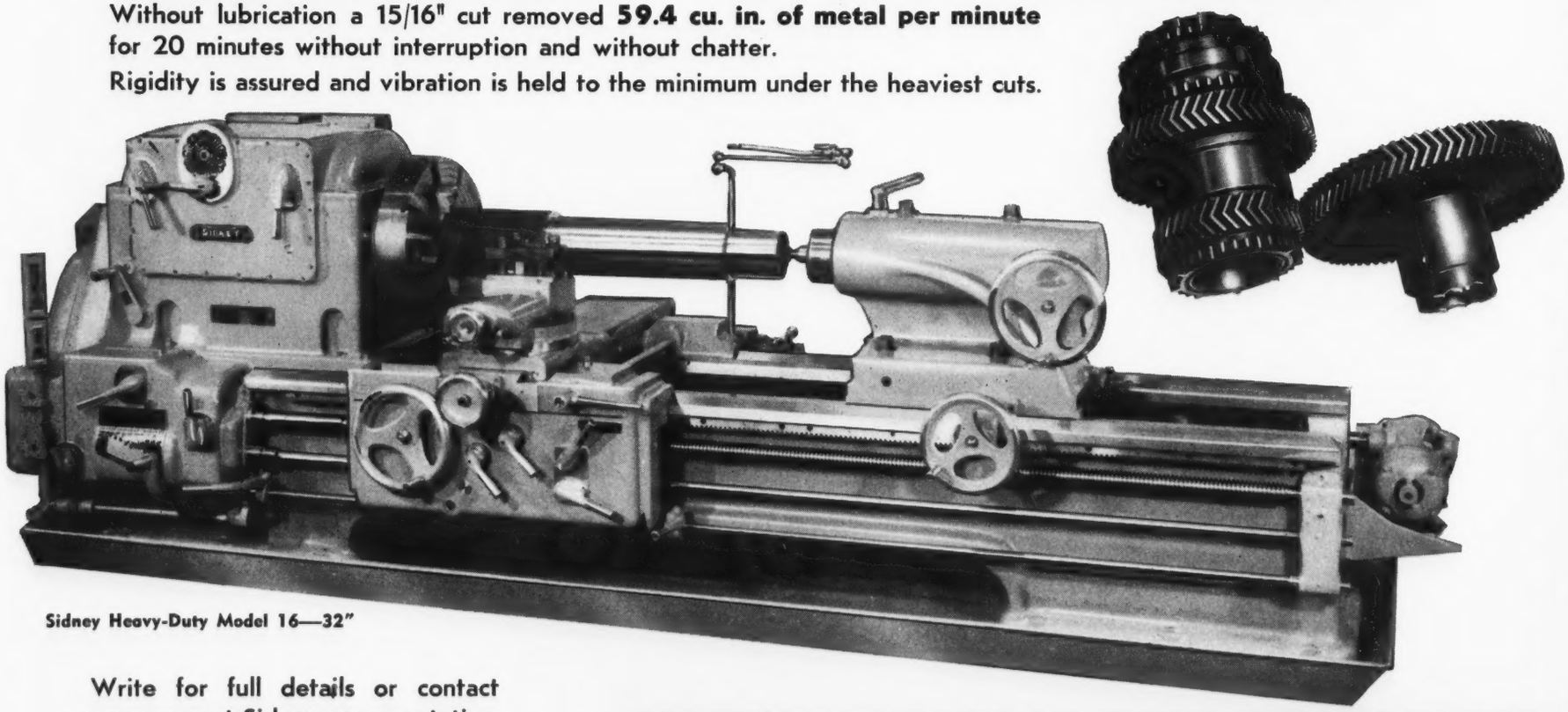
Cut Costs To The Minimum

SIDNEY HEAVY-DUTY LATHES

"COST MISERS"

CARBIDE TOOLS CAN BE USED TO UTMOST EFFICIENCY

Without lubrication a 15/16" cut removed **59.4 cu. in. of metal per minute** for 20 minutes without interruption and without chatter.
Rigidity is assured and vibration is held to the minimum under the heaviest cuts.



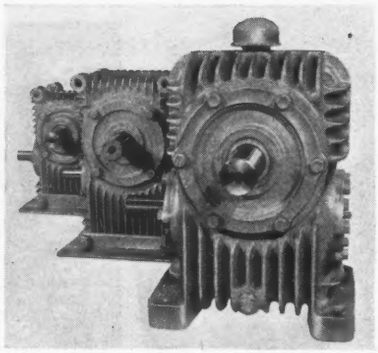
Sidney Heavy-Duty Model 16—32"

Write for full details or contact your nearest Sidney representative.

A SIDNEY LATHE IS THE FINEST TURNING TOOL EVER PRODUCED

SIDNEY MACHINE TOOL COMPANY • SIDNEY, OHIO

BUILDERS OF PRECISION MACHINERY SINCE 1904



Cone-Drive Speed Reducers

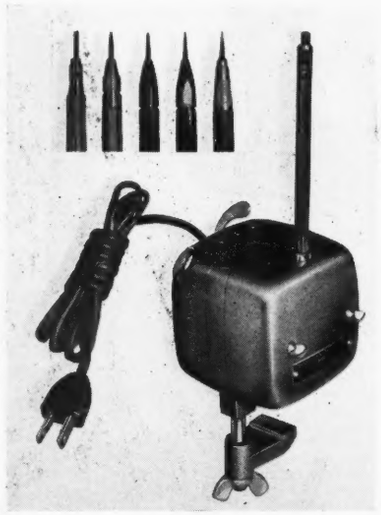
New line of Cone-Drive standard-duty speed reducers, characterized by improved appearance and greater casting uniformity. These reducers have double-enveloping gearing, and all operating parts are directly interchangeable with those of former models. Shown left to right are reducers having 2-, 2 1/2-, and 3-inch center distances. They are available in standard ratios of 5 to 1 up to 50 to 1, and in a 60 to 1 ratio in the 3-inch model. Power ratings range as high as 9.04 H.P. at 1750 R.P.M. Built by Cone-Drive Gears Division, Michigan Tool Co., Detroit, Mich. 92

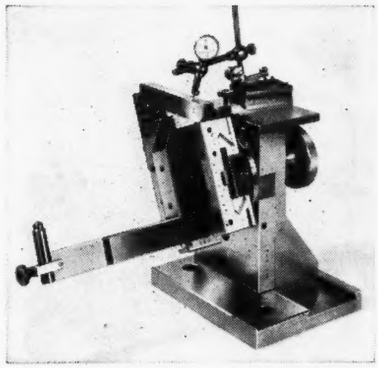
Federal Portable Thickness Gage

Portable thickness gage recently announced by Federal Products Corporation, Providence, R. I. This Model 644 gage is used for rapid checking of sheet and strip stock. It is especially adapted for use in checking incoming material to insure receipt of proper stock sizes; issuing sheets of correct thickness from stock room for blanking, drawing, and other operations; and measuring stock before and after plating to determine thickness of plating. Measurements are transferred to a dial indicator graduated to 0.001 inch, through the hardened steel upper and lower contact points. The wide-faced, spring-loaded upper and lower anvils grip and hold the gage perpendicular to the stock surface. The indicator can be furnished with either a direct or a continuous reading dial. 93

Rajean Precision Drafting-Lead Sharpener

Precision sharpener for shaping the inserted lead of mechanical drafting-lead holders to the five types of points needed for the various widths of lines used on a single drawing. Produces a predetermined point consistently. A lever provides for adjusting to suit the various size points. The unit operates on 115-volt 60-cycle alternating current. It is made by the Rajean Mfg. Co., Racine, Wis. 94





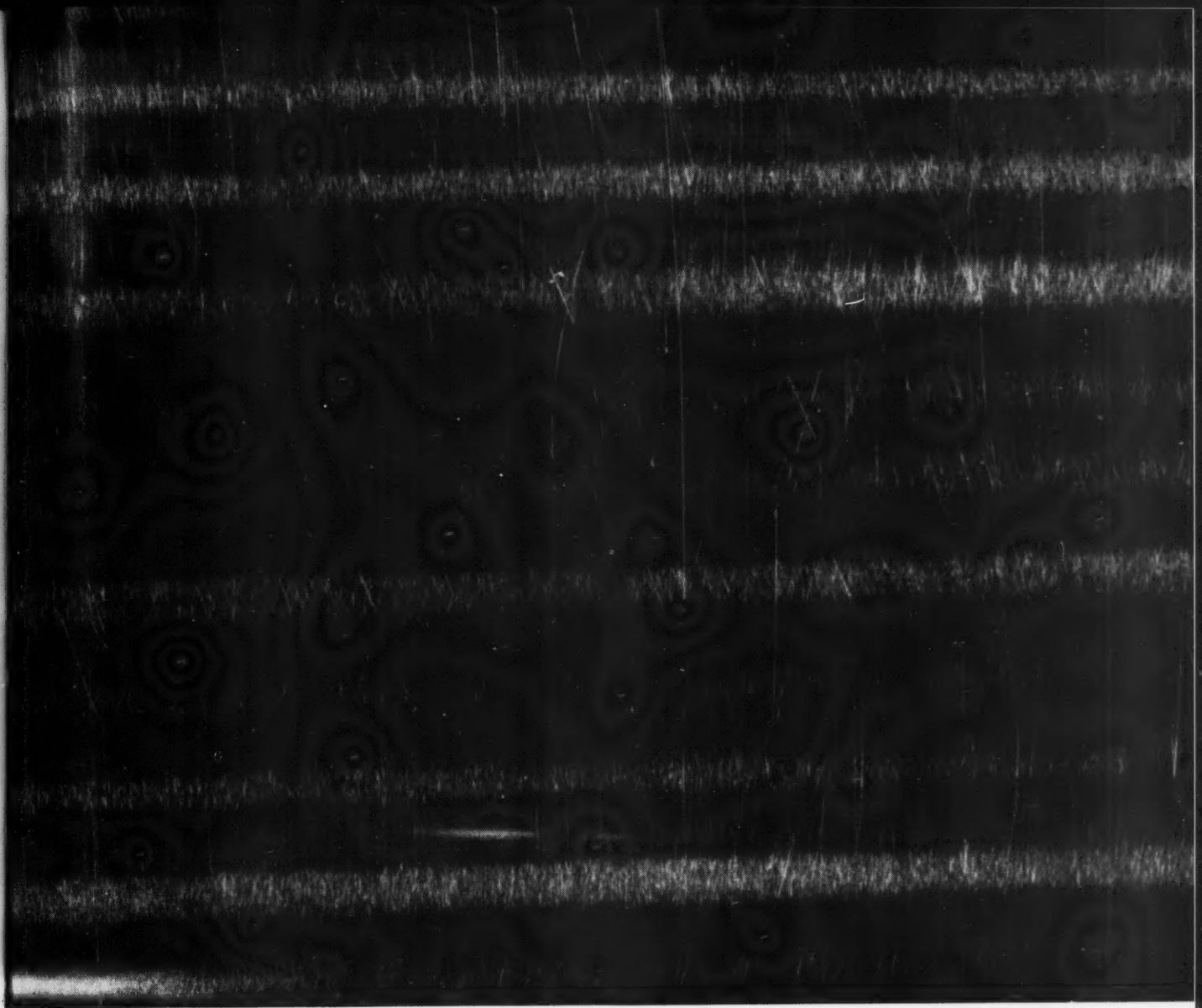
Universal Grinding Wheel Dresser

Universal grinding wheel dresser designed for dressing a complete form, rather than a single radius surface. This is made possible through gage-block controlled movements in the column and base. Angle settings are made by using a sine bar and graduated scales. Preloaded ball-bearing angle slides and rotating bearings are used to obtain the rigidity necessary for precision work. When gooseneck is removed, the dresser can be used as a revolving fixture for the rolling of radii. All setting positions have a 0.200-inch step for making adjustments from 0.0001 inch up. Positive locks and stops prevent any chance of distortion. Brought out by Universal Form Tool Co., Detroit, Mich. 95

"Pul-Lift" Portable Hoisting or Pulling Device

Link-chain model "Pul-Lift" portable device for hoisting or pulling, announced by Yale & Towne Mfg. Co., Philadelphia, Pa. By the use of link chain, the applications of the "Pul-Lift" are now multiplied to include thousands of new maintenance and production jobs in small and large plants, garages, construction projects, and machine shops. Work positioning, hoisting, and stretching trolleys, telephone wire, and even cables, are a few of the suggested uses. The new device is light in weight and easy to operate. Now available in 3/4-, 1 1/2-, and 3-ton capacities. 96

To obtain additional information on equipment described here, use Inquiry Card on page 229.



This roll looked perfect...

until SUPERFINISH revealed these defects!

Everybody said it was as perfect a finish as you'd ever see. A 12" steel roll ground down to a smoothness of less than 2 micro inches—dazzlingly reflective from end to end. Not a visible defect —*on the surface.*

But when SUPERFINISHING began, some interesting marks appeared—longitudinal flat spots—defects produced by the prior operation and then covered up by the heat of grinding.

SUPERFINISH brings these hidden troubles out in the open—out where you can see them and recognize the cause. And if your troubles are not too serious, SUPERFINISH can correct them economically and fast.

If you have fine finish requirements it will pay you to write for the booklet "Wear and Surface Finish."

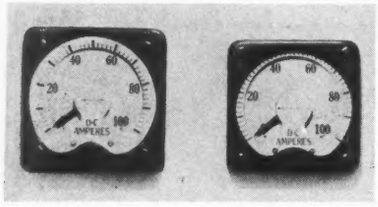
THE GISHOLT ROUND TABLE
represents the collective experience of specialists in the machining, surface finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

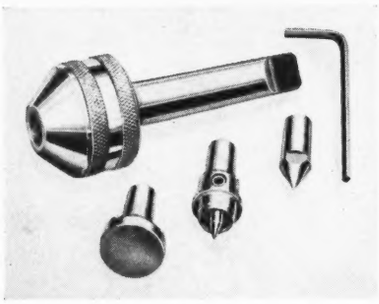
Westinghouse "Full-View" Switchboard Instruments

"Full-View" circular-scale switchboard instrument shown at left now available from the Westinghouse Electric Corporation, Pittsburgh, Pa. This instrument is designed to provide maximum readability from the steepest angles and to eliminate objectionable shadows on the scale, even under adverse lighting



conditions. The new "Full-View" design is the same as the original type K-24 shown at the right except for the cover and dial. The cover of the new instrument is approximately 3/8 inch wider and higher. The two types can be used interchangeably. 97

wear. The unit is powered by a dry-disk Power Pack, selenium rectifier. The chrome deposit can be controlled to close thickness tolerances. 98



Equipment for Chrome-Plating Tools and Wearing Surfaces

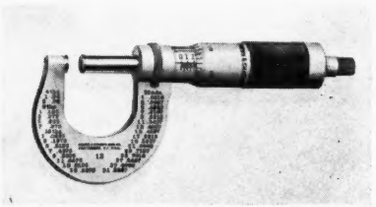
New hard chrome-plating equipment consisting of Model A-20 "Chromaster" plating equipment and "Chromasol" chrome-plating solution, announced by the Ward Leonard Electric Co., Industrial Chrome Divi ion, Mount Vernon, N. Y. This portable equipment is said to provide a quick means of applying hard surfaces that will increase from three to ten times the normal life of cutting tools and parts subjected to

Delta Ball-Bearing Center

Ball-bearing center designed for use on lathes, grinders, screw machines, gear-hobbers, and similar machines. The double row of sealed, lubricated-for-life ball bearings of this No. 1490 center are designed to take exceptionally heavy radial and thrust loads and eliminate chatter. The center socket is drilled and machined after assembly to assure accurate alignment. The shank has a No. 2 Morse taper. Made by the Delta Power Tool Division, Rockwell Mfg. Co., Milwaukee, Wis. 99

New Line of Brown & Sharpe Micrometers

One of a completely new line of outside micrometer calipers designed to make precision measuring easier, provide greater assurance of accuracy, and lengthen the life of the micrometer. A few of the major improvements are carbide measuring faces; large-diameter thimble with wide-spaced divisions for



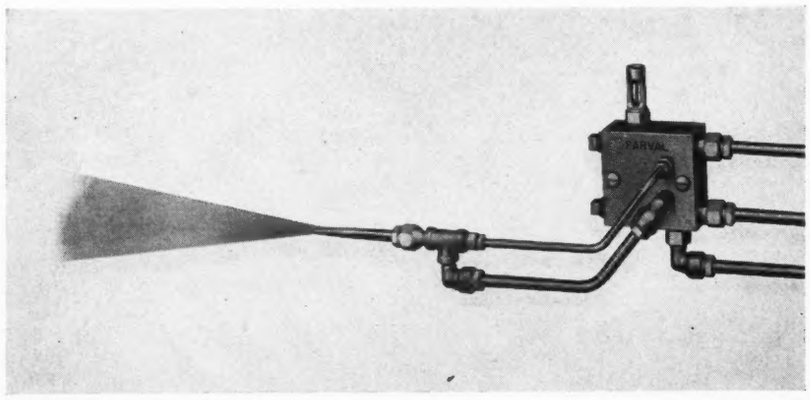
easy reading; one-piece stainless-steel spindle and screw; and hardened and ground threads for a long accurate life. Additional features include dull chrome finish, sliding taper thread adjustment, positively locked screw and thimble, and longitudinal thimble adjustment. Announced by the Brown & Sharpe Mfg. Co., Providence, R. I. 101

Airco Transformer Welder

Airco 200-ampere Model MCX transformer welder, the latest development in the Wilson line to be announced by the Air Reduction Sales Co., New York City. This arc-welder is a small, compact machine, 12 by 17 by 23 inches in size, designed to cover a wide range of applications from light-duty sheet-metal work to heavy-duty industrial welding. It has a full 200-ampere, 50 per cent duty cycle, NEMA rating. Three current ranges, selected by insulated tapered plug connectors, and infinite hand-crank adjustments within each range provide currents from 30 to 250 amperes. This permits the use of electrodes from 1/16 to 3/16 inch in diameter. 102

Farval Spray Valve for Lubricating Gearing

Adaptation of "Farval Dualine" valve developed by the Farval Corporation, Cleveland, Ohio, for spraying either grease or oil through a nozzle on slide surfaces and open gearing in predetermined amounts and at desired intervals. The valve can be added at any point in a regular Farval Dualine centralized lubrication system where compressed air is available or a complete system can be employed consisting entirely of spray valves served by either a manual or an automatic pumping unit. 100



To obtain additional information on equipment described here, use Inquiry Card on page 229.

By E. S. Salichs

BETWEEN GRINDS

Don't Clock the Clerk

The "chief cook and bottle-washer" type of position in which duties vary widely is familiar to everybody. But usually the business title of such a versatile man reflects only the "chief cook" aspects of his job. However, we just came across an honest soul in a well established machine tool company who signs himself "Vice-President and Clerk."

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The tires on your automobile were molded to within 5/100 of an inch of a true circle (which you immediately alter by stopping on a dime, starting up like a jack rabbit, and riding on the rims). But B. F. Goodrich engineers were asked to make really round tires for use on a special carriage at the National Advisory Committee for Aeronautics' Impact Basin, for both water tests with seaplane floats and impact tests with an airplane wheel touching a concrete runway. So they rolled and rolled (or however they get a tire this round) and came up with twelve solid rubber tires within 2/1000 of an inch of being absolutely cylindrical.

Shipshape

Kablegram, house organ of Kable Printing Co., gives the derivation of "spic and span." *Spic* (or spike) is a nail, and *span* is German for a chip thrown off in shaping timber for a boat. So *spic and span* originally was descriptive of a new boat. The Dutch use the word "spikspelderniew" in referring to a product just turned out by a workman.

Lester Goes Latin

Sombrero in hand, the Mexican sales engineer now calls on customers fortified by Bernard Lester's advice "La Perseverancia en el Exito de un Ingeniero de Ventas." We hastened to look up exito in the Spanish-English dictionary, and were relieved to find it means success, and not exit which must have a harsh connotation to salesmen in any language. Anyway, the Sales Engineer article appeared in the journal of the Mexican Association of Mechanical and Electrical Engineers with MACHINERY'S permission.

Uncle's Helpers

An inventor wrote to us about his patent for a new irrigation control system, and went on to say, "I have six nephews and three nieces in Bethlehem and Allentown, Pa., who are now representing me in the United States." Sitting at the holiday dining board, he must have talked turkey while he ate it.

By George!

We were reading a pamphlet in which a foreign trade consultant was urging exporters to help their foreign clients sell their wares here, so that they might have the dollars to pay for the exports. Said he, "The doctrine of 'Let George do it' is dangerous. *You are George.*"

CURRENTLY CORRESPONDING — Loring F. Overman is author of the new monthly column "Keeping Up with Washington" (page 129), to which he brings a colorful background of thirteen years' work in the national capital. Mr. Overman is a native of Spokane, Wash., where he spent his youth; interrupting his schooling with a tour of duty in the World War I Navy, he returned to Spokane and started his writing career on a newspaper. Then for the next decade he was an account executive with West Coast advertising agencies, continuing as a newspaper and trade journal correspondent on the side. In 1937, he moved on to Washington, D. C., becoming trade promotion manager for a national trade association, whereupon he also originated and ran a trade publication for the Association. Since that time, Mr. Overman has been in close contact with Government agencies, and during the last war interpreted WPA, OPA, CMP, and all the other alphabetical regulations in the shape of bulletins and news letters. Now, again, with the awakening of Washington to the country's urgent need, our correspondent is on deck to help keep us aware and informed of the latest activities, decisions, and programs bearing on the metal-working industries.

News of the Industry

Arizona and Texas

CARBOLOY COMPANY, INC., Detroit, Mich., has appointed McCONKEY-DOCKER & Co., 126-132 W. Madison St., Phoenix, Ariz., distributor of Carboloy tools and blanks throughout the state of Arizona.

DALLETT CO., Philadelphia, Pa., manufacturer of pneumatic tools, which was purchased in 1947 by the REED ROLLER BIT CO., has been moved to the Cleco Division plant of the company in Houston, Tex.

Illinois and Iowa

GEORGE L. BACHNER, president of the Powdered Metal Products Corporation of America, Franklin Park, Ill., has been appointed industrial consultant to the Chief of Ordnance, U. S. Army. He will head a committee to pass on the suitability of powdered-metal fabrication for specific ordnance requirements. Announcement has also been made of plans for a new addition to the company's Belmont Ave. plant. This is the first step in a facilities expansion program which will double the present production capacity.

WHITING CORPORATION, Harvey, Ill., manufacturer of cranes, foundry equipment, and railroad equipment, has opened a district sales office in Seattle, Wash., at 350 Skinner Bldg. R. E. FLORINE is district manager of this office. Another new sub-sales office has been opened at 637 Penton Bldg., Cleveland, Ohio, with A. C. KUKRAL as resident sales engineer.

CHARLES H. BESLY & Co., manufacturer of taps, twist drills, reamers, and grinding machinery, has appointed ELLIS C. WESTER sales manager of the Cutting Tool Division, and HAL SEGER manager of drill and reamer sales. Both these men will be located at the company's headquarters at 118 N. Clinton St., Chicago, Ill.

BERNARD STAPP has joined the sales organization of Chicago-Latrobe, Chicago, Ill., manufacturer of drills, reamers, and special tools. He will serve as district manager of the south central territory, with headquarters in Fort Worth, Tex., succeeding VICTOR E. GRIFFIN, who has been transferred to Detroit, Mich.

HARRY L. EMERSON has been appointed vice-president in charge of manufacturing of the Rockford Clutch Division of the Borg-Warner Corporation, Rockford, Ill. He will continue to hold the position of works manager which he has occupied for eight years.

HENRY L. LEMAY has recently been appointed Chicago district manager of the Mid-West Abrasive Co., Owosso, Mich. His headquarters will be at the Railway Exchange Bldg., 224 S. Michigan Ave., Chicago, Ill.

ROBERT T. DAILY has been promoted to the position of field engineer in charge of the Chicago office of the Lord Mfg. Co., Erie, Pa.

S. J. SMITH CO., 410 W. River St., Davenport, Iowa, has been appointed a dealer for Airco gas and electric arc-welding equipment, supplies, and accessories made by the AIR REDUCTION SALES CO., New York City.

Michigan and Wisconsin

TAFT-PEIRCE MFG. CO., Woonsocket, R. I., has appointed the GOTTSMAN MACHINERY CO., 2457 Woodward Ave., Detroit, Mich., sales representative for the machine tools made by the company. Sales of the company's line of gages and small tools will continue to be handled through the Taft-Peirce branch office at 10700 Puritan Ave., Detroit.

GEORGE K. GARRETT CO., INC., manufacturer of lock-washers, hose clamps, springs, and stampings, announces that the Detroit branch of the company has just moved into its own building at 15755 James Couzens, Detroit 21, Mich. This branch of the company is under the direction of J. A. COTTER, who has been appointed district sales manager.

CLEVELAND INDUSTRIAL TOOL CO., Cleveland, Ohio, manufacturer of diamond tools, has recently opened a Michigan Sales Division at 10526 Grand River Ave., Detroit. C. A. HUBLEY is manager of the new division, and KEN C. BOALEN has been made field engineer.

WALTER C. FOOTE has been made sales manager of the Dearborn Gage Co., Dearborn, Mich., manufacturer of Ellstrom chromium-plated gage-blocks and other quality control and precision measuring equipment.

RICHARD BROWN was recently appointed director of personnel of the Ingersoll Steel Division of the Borg-Warner Corporation, Kalamazoo, Mich. DEE WILLIAMS has been made employment supervisor.

MACDERMID, INC., Waterbury, Conn., has appointed the DONALD SALES & MFG. CO., 6601 W. State St., Milwaukee 13, Wis., distributor for the company's line of metal cleaners and metal finishing preparations.

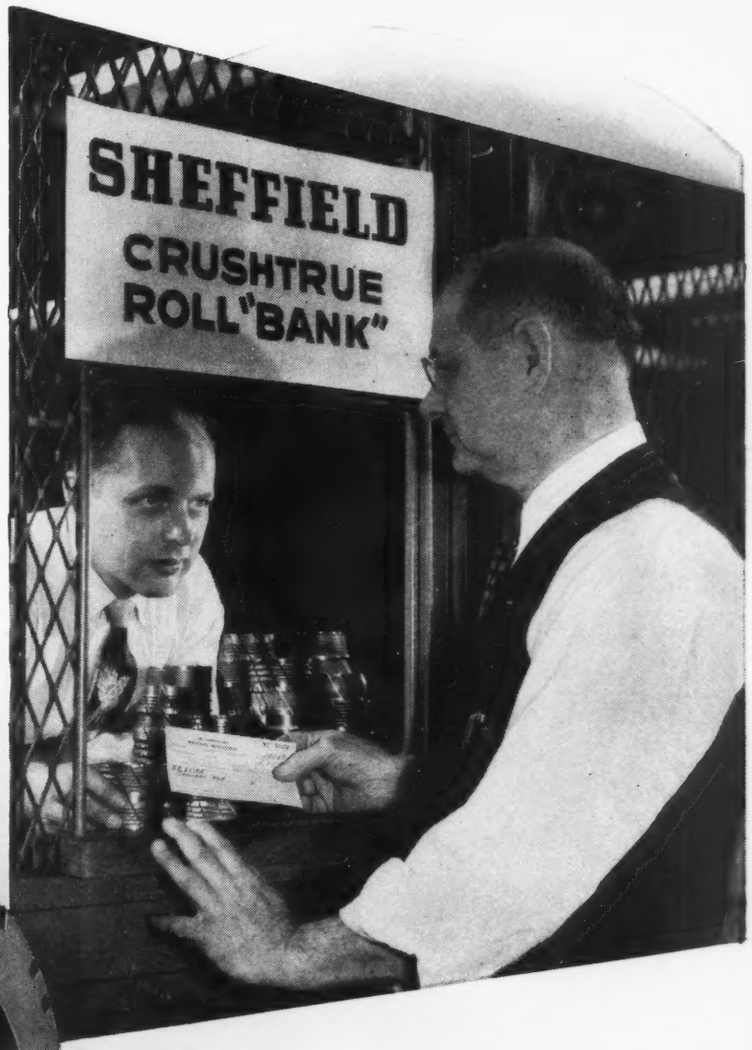
New England

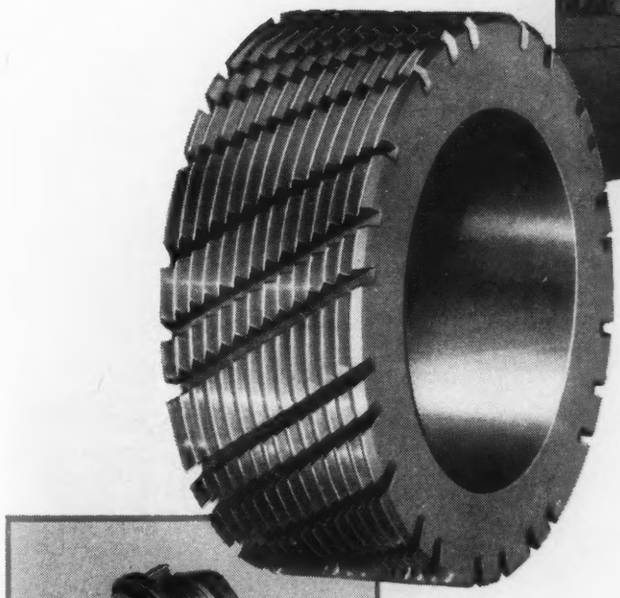
HENRY D. SHARPE, JR., was elected a vice-president of the Brown & Sharpe Mfg. Co., Providence, R. I., at a recent meeting of the board of directors. After graduating from Brown University in 1944, Mr. Sharpe

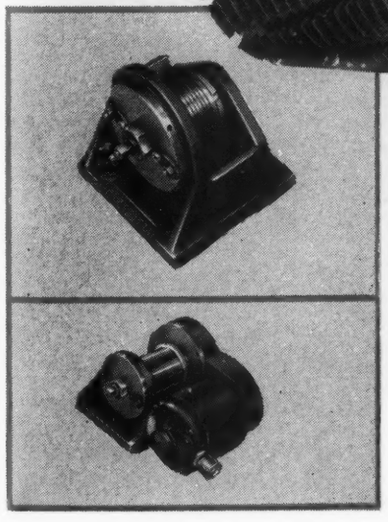
(Left) Henry D. Sharpe, Jr., recently elected vice-president of the Brown & Sharpe Mfg. Co. (Right) Paul R. Hatch, assistant secretary

Sheffield Bank

offers you important savings on thread and form grinding







"Withdrawals without waiting—and at a cost of little more than handling charge."

That's the Sheffield Crushtrue Roll Bank service on rolls for crush-dressing grinding wheels for threaded and other profiled work.

Crushtrue Rolls for any standard U.S. thread form 8 to 32 pitch are always "on deposit" awaiting your "withdrawal". Identical service can be arranged for any special thread or other profile.

Only once do you pay the full price for any NEW specific roll. Thereafter, merely return your roll requiring regrinding, a replacement will be shipped usually within 24 hours at a nominal price much lower than the cost of a new roll. This can go on indefinitely, as long as the "depositor" desires.

To enjoy savings and dividends by "opening an account" at Sheffield, let us know of your requirements. Call, wire or write for data on cylindrical and surface Crushtrue grinding equipment.

MASTER CRAFTSMEN SHEFFIELD HEADQUARTERS

the *Sheffield* corporation
Dayton 1, Ohio, U. S. A.

GAGES • MEASURING INSTRUMENTS • MACHINE TOOLS • CONTACT SERVICES • THREADING TOOLS

spent three years of active duty in the Navy and then entered the Brown & Sharpe Training Course. Upon completing this course, he was assigned to the administrative offices. In 1948, he was elected an assistant secretary, and in 1949, a director of the company. PAUL R. HATCH was named assistant secretary at the same directors' meeting. Mr. Hatch has been identified with the sales department since becoming connected with the organization in 1927. He was appointed manager of the New York City office in 1939, and two years later was transferred to Providence to direct the sale of small tools. In 1947, he was made head of the sales department. In addition to filling the office of assistant secretary, Mr. Hatch also serves as general sales director.

H. S. Sizer, assistant to director of design of Brown & Sharpe Mfg. Co., who has recently been elected a director of the American Standards Association

H. S. SIZER, assistant to the director of design of the Brown & Sharpe Mfg. Co., Providence, R. I., has been elected a member of the board of directors of the American Standards Association to serve for a three-year term beginning January 1. Mr. Sizer is chairman of the Technical Standards Committee of the National Machine Tool Builders Association. He is also vice-president of the Providence Engineering Society and a member of the American Society of Mechanical Engineers and the American Gear Manufacturers Association.

JULIAN G. TABOR, who has had charge of the Hartford office of the Brown & Sharpe Mfg. Co., Providence, R. I., since 1920, retired on December 1 after forty-five years of service with the company. Mr. Tabor became connected with the Brown & Sharpe organization as a machinist's apprentice and later completed a draftman's apprenticeship. He served in various capacities in the shop and sales departments before assuming his duties at Hartford. HERBERT RICHARDSON, of the Philadelphia office, will succeed Mr. Tabor as Hartford representative. It is announced that henceforth the sale of all products of the company in the state of Connecticut, including small tools, will be handled directly from the Hartford office.

PAUL J. RODDY has been made assistant domestic sales manager of the Nicholson File Co., Providence, R. I., succeeding EDMOND A. NEIL, whose appointment as domestic sales manager was announced in December MACHINERY.

WILLIAM J. GREENE, vice-president and director of sales of the L. S. Starrett Co., Athol, Mass., was recently elected a director of the Motor Equipment Manufacturers Association for a three-year term. Mr. Greene has also been appointed a member of the executive committee of the American Supply & Machinery Manufacturers Association.

DR. EDWARD M. PRITCHARD has been made chief electrical engineer of the Control Engineering Corporation, Canton, Mass. He was previously chief engineer for the Fisher-Pierce Co. and chief applications engineer for the Sigma Instrument Co.

S. B. FUERST has been named supervisor of methods and equipment at the Fitchburg, Mass., Works of the General Electric Co.

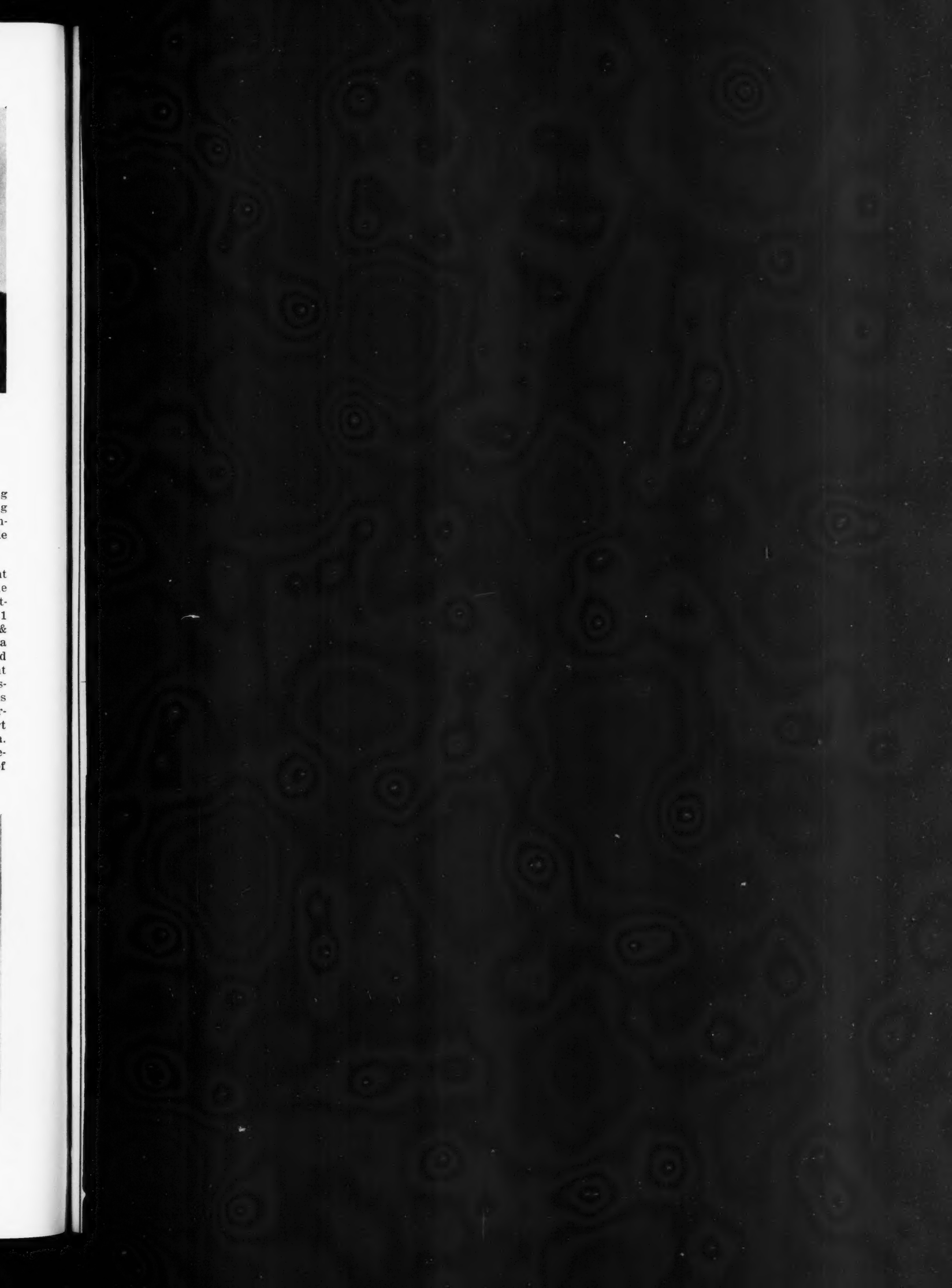
ROBERT A. BODE has been appointed sales manager of the Hartford Special Machinery Co., Hartford, Conn.,

Edward P. Gillane recently elected vice-president and general manager of Potter & Johnston Co.

manufacturer of automatic drilling and tapping machines, die polishing machines, and other special machinery. J. JAMES TASILLO has been made assistant sales manager.

CLAYTON R. BURT, former president and chairman of the board of the Niles-Bement-Pond Co., West Hartford, Conn., retired on October 1 from the presidency of the Potter & Johnston Co., Pawtucket, R. I., a subsidiary of the Niles-Bement-Pond Co. FREDERICK U. CONARD, president and general manager of the Niles-Bement-Pond Co. (which includes the Pratt & Whitney and Chandler-Evans Divisions) succeeds Mr. Burt as president of Potter & Johnston. EDWARD P. GILLANE was elected vice-president and general manager of the Potter & Johnston Co.

(Left) Robert A. Bode, newly appointed sales manager of the Hartford Special Machinery Co. (Right) J. James Tasillo, assistant sales manager of the company



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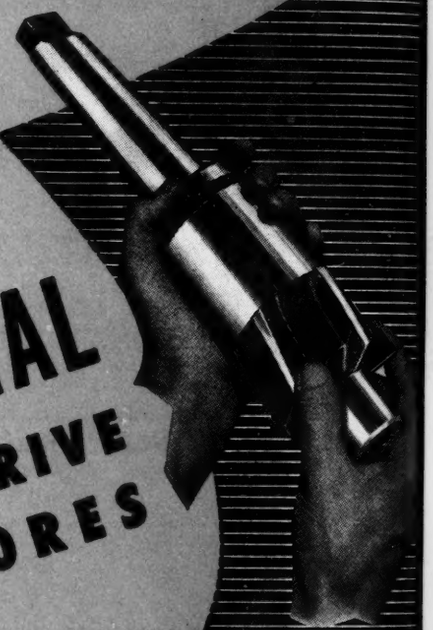
Above: Counterboring a hole in a cast iron machine base. Uniformity of chips indicates free-cutting action; chip disposal is aided by wide flutes. And when the operation is finished the cutter is removed from the holder with a simple *twist of the wrist.*

HAND DETACHABLE EVEN AFTER THE TOUGHEST CUTS



CONTINENTAL STANDARD DRIVE COUNTERBORES

CTW

There's no wedging action in Continental Standard Drive Counterbores. Cutters are removable from the holder with a simple *twist of the wrist,* even after the toughest cuts. Double driving lugs on the cutters engage double abutments in the holders to give a balanced, positive drive that practically is indestructible. Double bearing areas in the drive assure rigidity and proper alignment of cutters and holders. Continental Counterbores are available individually or in sets that include holders, cutters, countersinks and pilots in practical size ranges.

The new Continental Catalog lists various counterbore holders and cutters (in high speed steel and carbide tipped). For your free copy, write on your company letterhead. Please ask for Catalog No. 60681.

CONTINENTAL TOOL WORKS

Division of Ex-Cell-O Corporation

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New York and New Jersey

JOSEPH F. ECKEL has been appointed manager of the Large Motor and Generator Divisions of the General Electric Co., Schenectady, N. Y., and J. W. BELANGER has been made assistant general manager of the Apparatus Department. Mr. Eckel succeeds J. M. CRAWFORD, who was recently transferred to Pittsfield, Mass., as manager of the Transformer and Allied Product Divisions. HERBERT L. ROSS, manager of manufacturing of the Meter and Instrument Divisions, takes Mr. Eckel's former post as manager of the River Works at Lynn, Mass., and is succeeded by HENRY A. VAUGHN as manager of manufacturing of the Meter and Instrument Divisions.

WARD LEONARD ELECTRIC CO., Mount Vernon, N. Y., announces the establishment of an Industrial Chrome Division, which is engaged in the development and manufacture of chrome-plating units, solutions, and processes, for the hard chrome-plating of machine tool accessories and component parts. Exclusive license for the manufacture and sale of the chrome-plating solution and plating unit used in the process has been obtained by the company from Chromecraft Corporation, Chicago, Ill. WILLIAM G. DAWSON is manager of the new division.

VEEDER-ROOT, INC., Hartford, Conn., manufacturer of counting and computing devices, has opened a direct factory branch in New York City, taking over the office formerly occupied by the company's distributor, J. T. QUINLAN CO., at 1775 Broadway. The company's line of general industrial counters for mechanical and electrical operation, as well as textile counters, will be sold and serviced at this office. Mr. Quinlan will continue in an advisory capacity.

SINTERCAST CORPORATION OF AMERICA, powder metallurgy specialist, announces the removal of its office, laboratory, and production facilities from New York City to larger quarters in Yonkers, N. Y. Until its recent acquisition of the WRIGHT CARBIDE CO., East Orange, N. J., the corporation was primarily a research and development organization. Now it has added the production of standard and special-purpose powdered-metal parts to its activities.

E. A. ERICKSON has been made manager of the Hornell, N. Y., plant of S K F Industries, Inc., Philadelphia, Pa., manufacturers of ball and roller bearings. Since 1947, Mr. Erickson has been shop superintendent at Hornell. He has been with the company for thirty-eight years. HARRY R. FILLMORE has been advanced from general foreman to assistant plant manager of the Hornell plant.

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Ohio

JOSEPH T. RYERSON & SON, INC., steel distributors, announce that they have recently moved into a new and larger steel-service plant and office building at 3475 Spring Grove Ave., Cincinnati, Ohio. The company's former quarters were at Front St. and Freeman Ave. The new plant represents an investment of over one million dollars, and has a total floor space of 165,000 square feet. The layout of the plant is such as to afford maximum ease and speed in processing and handling incoming and outgoing shipments of steel. Complete equipment has been installed for cutting and otherwise preparing steel to suit customers' requirements. One of the modern machines installed is a 200-H.P. friction saw unit with a 62-inch blade capable of cutting large work, such as structural members, in a matter of seconds. An electric-eye controlled flame-cutting machine has also been installed for cutting intricate shapes. A portion of the warehouse is heated so as to preserve and protect the finish of special types of bars and flat-rolled steel while in stock.

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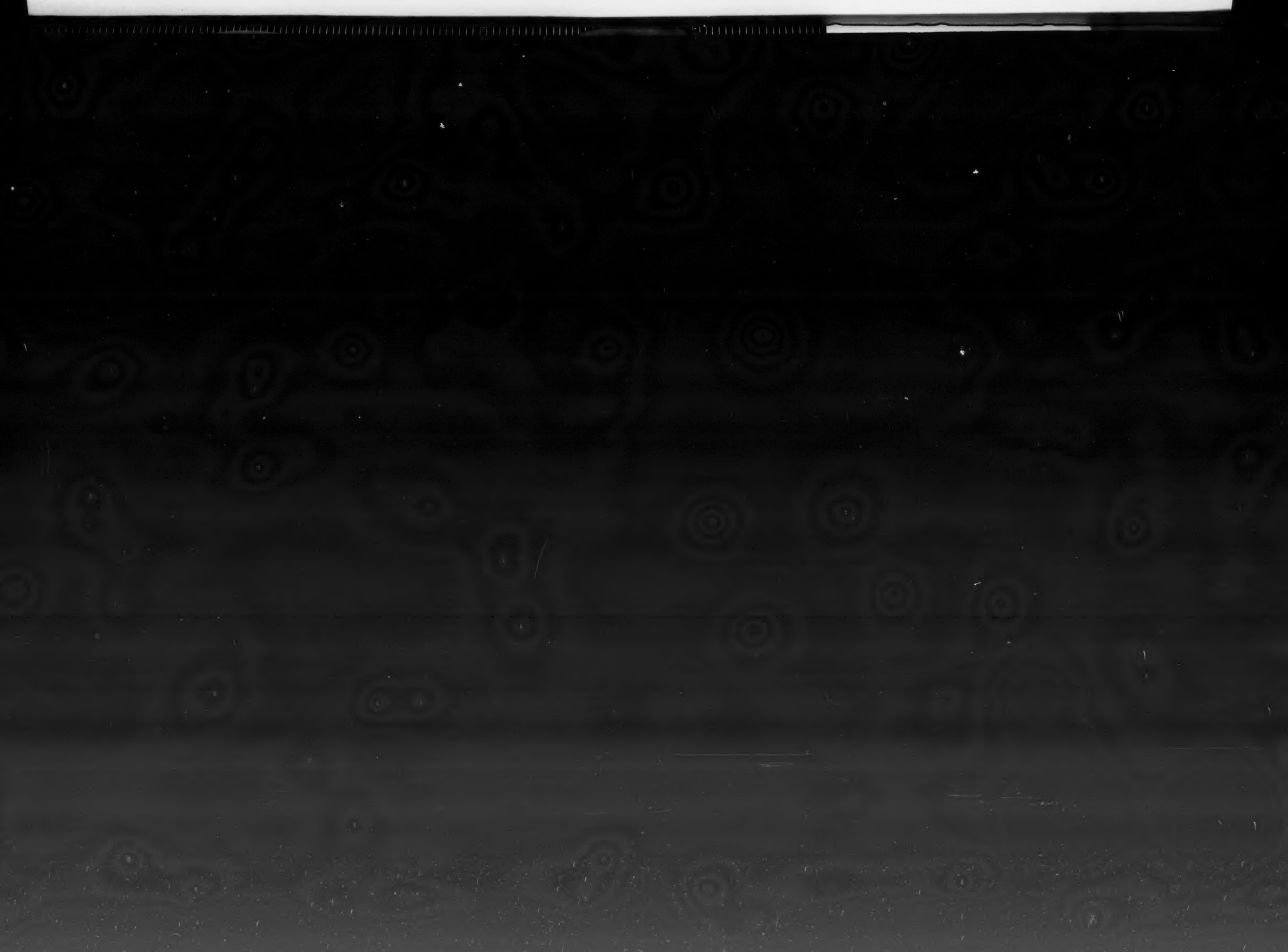
JAMES WILLIAM BROOKS has assumed sales and engineering responsibilities for the Lincoln Electric Co., Cleveland, Ohio, in the Indianapolis district. He has been transferred to his new post from Boston. THOMAS L. DEMPSEY has been added to the staff of the Cleveland sales organization as a special field engineer. JOHN F. KOTCHIAN has been appointed welding engineer in the company's Chicago district, to which he has been transferred from Cleveland.



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George H. Lynn, general sales manager of Hamilton Division, Baldwin-Lima-Hamilton Corpn.

GEORGE H. LYNN has been appointed general sales manager of the Hamilton Division, Baldwin-Lima-Hamilton Corporation, Hamilton, Ohio. Mr. Lynn joined the Lima-Hamilton Corporation in 1947, serving as western sales manager of the Niles and Hooven Divisions. Prior to that he was associated with the Axelson Mfg. Co. for seven years in various sales capacities. The Hamilton Division manufactures machine tools, can machinery, Dierel engines, and miscellaneous special equipment.

BRUSH DEVELOPMENT CO., Cleveland, Ohio, manufacturer of the Brush surface analyzer, has recently expanded its line of surface measuring instruments by purchasing the business of the FAXFILM CO., also of Cleveland. This combination of the Brush surface analyzer and Faxfilm will provide for both quantitative and qualitative surface analysis.

ROY J. DUSSEAU has been made district manager in charge of the Dayton, Ohio, office of the E. W. Bliss Co., manufacturer of metal-working presses. He was previously general manager of the Meisel Machine & Tool Co., of Toledo.

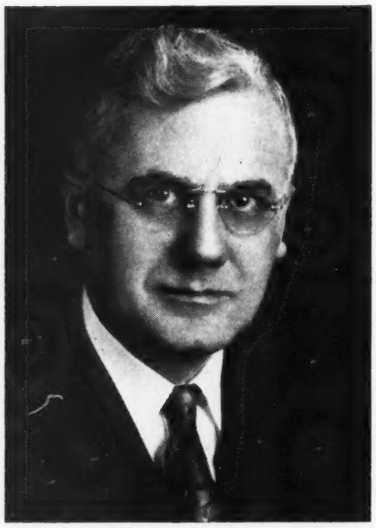
C. F. DUFF, formerly Cleveland representative of the Morse Twist Drill & Machine Co., New Bedford, Mass., has been made district manager of Ohio and Indiana. He will be succeeded at Cleveland by A. E. BOOT and HAROLD SYMES.

HAROLD R. POTTER has been appointed district sales manager of the Carpenter Steel Co., Reading, Pa., with headquarters at Cleveland, Ohio. He succeeds JAMES S. BAILEY, who has been named assistant to the vice-president in charge of sales.

Pennsylvania and West Virginia

MOORE PRODUCTS CO., Philadelphia, Pa., announces the opening of a Pittsburgh branch office at 3031 W. Liberty Ave., Pittsburgh 16, Pa. R. H. OWENS, formerly sales engineer for the company in northern New Jersey, is office manager of the new branch. The company also announces the formation of the MOORE INSTRUMENT CO., LTD., 155 Jane St., Toronto 9, Canada, to supply Canadian industries with Moore Nullmatic instruments and pneumatic comparator gages. K. G. MITCHELL is manager.

THOMAS D. JOLLY, vice-president of the Aluminum Co. of America, Pittsburgh, Pa., has been elected president of the American Standards Association. This will be his third one-year term as president.



Thomas D. Jolly, newly elected president of the American Standards Association

LINK-BELT CO., Chicago, Ill., announces that, in order to provide better service to industries in the greater Pittsburgh area, the company has constructed and is now operating a new factory branch store at 5020 Centre Ave., Pittsburgh 13, Pa., where a complete stock of power transmission and materials-handling products will be carried. The new building will serve as headquarters for the increased Pittsburgh personnel.

WELDON TOOL CO., Cleveland, Ohio, announces the appointment of the HARRIS PUMP & SUPPLY CO. as Pittsburgh distributor of the company.

ENGINEERING PRODUCTS CO., Charleston, W. Va., has been appointed sales representative for the line of magnetic separation equipment made by the ERIEZ MFG. CO., Erie, Pa.

Washington and California

NELSON J. LEONARD, who has long represented Cleveland Tramrail overhead materials-handling equipment in the state of Washington, has been granted a franchise to cover the entire northwest territory. Mr. Leonard's main office is located at 5764 Twenty-eighth Avenue, N.E., Seattle 5, Wash.

LAWRENCE M. RICH has been appointed vice-president and general sales manager of the Plomb Tool Co., Los Angeles, Calif., manufacturer of "Proto" tools.

Coming Events

JANUARY 15-18 — Second annual PLANT MAINTENANCE SHOW at Cleveland, Ohio. Sponsored by the American Society of Mechanical Engineers and the Society for the Advancement of Management. For further information, address Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

MARCH 15-17—Annual meeting of the American Society of Tool Engineers at the Hotel New Yorker in New York City. Executive secretary, Harry E. Conrad, 10700 Puritan Ave., Detroit 21, Mich.

MARCH 19-23 — Seventh WESTERN METAL EXPOSITION AND CONGRESS in the Auditorium and Exposition Hall in Oakland, Calif. Sponsored by the American Society for Metals, in cooperation with twenty other national technical societies. Secretary, William H. Eisenman, Exposition Hall, 918 Fallon St., Oakland 7, Calif.

MARCH 19-23—CONFERENCE ON INDUSTRIAL PERSONNEL at Columbia University, New York City. Further information and registration procedure can be obtained by addressing David N. Edwards, Instructor in Industrial Engineering, Columbia University, New York 27, N. Y.

APRIL 16-18—National convention of the AMERICAN SOCIETY OF LUBRICATION ENGINEERS at the Bellevue-Stratford Hotel in Philadelphia, Pa. National secretary, W. F. Leonard, 343 S. Dearborn St., Chicago 4, Ill.

APRIL 17-20—TWENTIETH NATIONAL PACKAGING EXPOSITION sponsored by the AMERICAN MANAGEMENT ASSOCIATION at the Auditorium in Atlantic City, N. J. Public relations director, Edward K. Moss, 330 W. 42nd St., New York 18, N. Y.

APRIL 23-26—Fifty-fifth annual convention of AMERICAN FOUNDRYMEN'S

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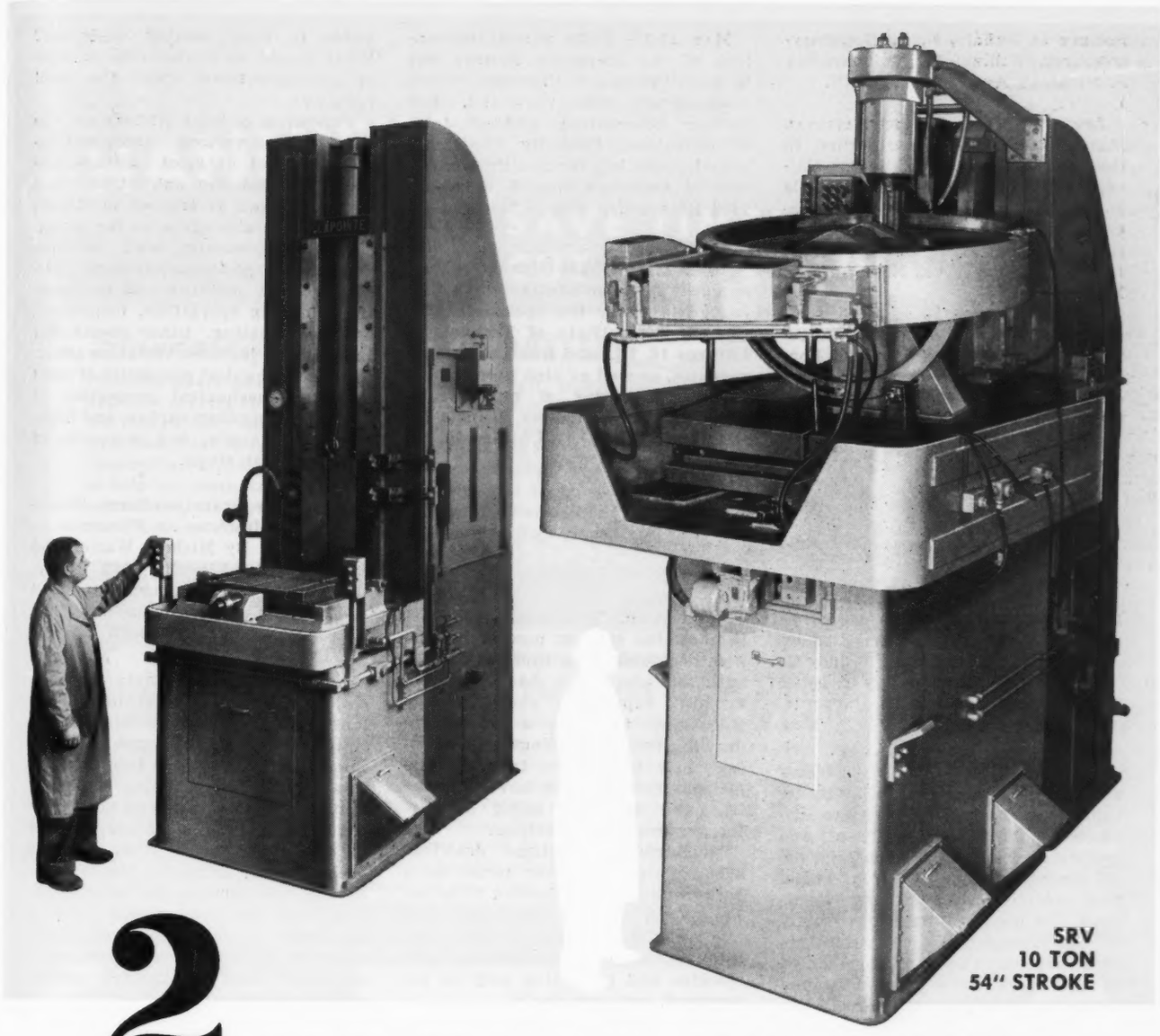

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IT'S THE LAPOINTE SINGLE RAM VERTICAL BROACHING MACHINE

✓ **Like *all* Lapointe Broaching Machines,** it is designed for great versatility, and can be adapted to many uses. It is *not* just a one-purpose machine, for it requires only new fixtures in order to broach an entirely different part from that for which it was originally purchased.

✓ ***Maybe this is your answer*** to the problem of how to tool up for defense contracts without running the risk of having needless machines on hand when those contracts are completed.

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APRIL 30-MAY 4—FOURTH NATIONAL MATERIALS-HANDLING EXPOSITION in the International Amphitheatre, Chicago, Ill. Sponsored by the Materials Handling Institute. Further information can be obtained from the exposition management, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.

APRIL 30-MAY 1[illegible]—BRITISH INDUSTRIES FAIR in Birmingham and London, England. Further information can be obtained from British Information Services, 30 Rockefeller Plaza, New York 20, N. Y.

MAY 23-24—Fifth annual convention of the AMERICAN SOCIETY FOR QUALITY CONTROL in Cleveland, Ohio; headquarters, Hotel Cleveland. For further information, address John F. Occasione, Publicity Chairman, American Society for Quality Control, care of American Steel & Wire Co., 1406 Rockefeller Bldg., Cleveland 13, Ohio.

JUNE 11-16—FIRST NATIONAL CONGRESS OF APPLIED MECHANICS in Chicago, Ill., under the sponsorship of the Ilinois Institute of Technology, Chicago 16, Ill., and three other universities, as well as nine professional societies. Director of public relations, James W. Armsey, Illinois Institute of Technology, Chicago 16, Ill.

New Books and Publications

INDUSTRIAL AND SAFETY PROBLEMS OF NUCLEAR TECHNOLOGY. Edited by Morris H. Shamos and Sidney G. Roth. 368 pages, 5 1/2 by 8 inches. Published by Harper & Brothers, 49 E. 33rd St., New York 16, N. Y. Price, $4.

The special technological problems and dangers connected with the development of atomic power are discussed in this volume by twenty-one leaders in the fields of industrial development, nuclear research, radiation medicine, and casualty insurance. The book is intended primarily for the layman rather than the technical expert. The papers presented in this book were prepared for a three-day conference sponsored jointly by the Atomic Energy Commission and New York University's Division of General Education. The material is divided into four sections dealing with the U. S. Atomic Energy Commission Activities; Radiochemistry and Isotopes; the Radiochemical Laboratory; and Hazards, Safety, and Insurance.

Specifically concerned with nonmilitary uses of atomic energy, this work should be of great importance to all engineers, businessmen, research workers, insurance personnel, and students who are connected with or interested in the constructive uses of atomic energy. It should be a highly useful reference volume for those who are using or contemplate using radioactive materials.

ILLUSTRATING FOR TOMORROW'S PRODUCTION. By J. Harold Farmer, Abbott J. Hoecker and Francis F. Vavrin. 203 pages, 6 1/4 by 9 1/2 inches. Published by the Macmillan Co., 60 Fifth Ave., New York 11, N. Y. Price, $5.

The art of illustration plays an important part in American industry as a visual aid in the various steps of production. This book is intended to show the student how to become a skilled production illustrator. The authors, who have had extensive teaching experience, show in easy steps how to make a perspective drawing from an orthographic drawing; how to make a true-scale exploded drawing; and how to make free-hand drawings using mechanical construction principles.

Isometric and oblique drawings are explained in clear terms as a background for production illustrating. Each step is illustrated and many of the illustrations are in two colors to make the mechanics of perspective and projection easy to understand.

The book also includes instruction in the preparation of drawings for reproduction and information on the various reproduction processes. A separate section explains the special techniques of aircraft illustrating, and the final part of the book shows some of the ways in which production illustrating can be used in advertising and in the development of new ideas or designs.

STEEL CASTINGS HANDBOOK (1950). 522 pages, 6 by 9 inches; 440 illustrations. Published by the Steel Founders' Society of America, 920 Midland Bldg., Cleveland 15, Ohio. Price, $4.

Long a standard reference book for engineers, designers, draftsmen, students, and others in the metalworking field, the "Steel Castings Handbook" has now been brought out in an extensively revised edition. The book provides the answers to such questions as: What are the advantages of using steel castings in mechanical structures and assemblies? How can steel castings best serve the engineering industries? What helpful information is available as a guide to steel casting designers? What should an engineering student or graduate know about the steel foundry?

Following a brief history of the industry, the various classes and industrial uses of steel castings are discussed and the subject of steel casting design is treated in detail. Attention is also given to the manufacturing processes, with sections dealing with pattern equipment, melting practice, molding and coremaking, finishing operations, inspection, and heat-treating. Other specialized information includes variables affecting the mechanical properties of steel castings; mechanical properties of low-carbon, medium-carbon, and high-carbon cast steels; and properties of low-alloy cast steels.

STRENGTH OF STAINLESS-STEEL STRUCTURAL MEMBERS AS FUNCTION OF DESIGN. By Michael Watter and Rush A. Lincoln. 153 pages, 7 1/2 by 10 3/4 inches. Published by the Allegheny Ludlum Steel Corporation, Pittsburgh 22, Pa. Price, $5.

Engineers and designers who are planning to use cold-rolled, high tensile-strength, chromium-nickel stainless steel in structures carrying calculated loads will be interested in this new work describing the basic properties of this material and methods of calculating the allowable loads for structures made from it. The book is not intended for the layman, having been written on the assumption that the reader will have a knowledge of mechanics and stress analysis. A method of stress analysis is developed and checked against empirical results.

The information offered includes basic tension and compression data; application of combined moduli data to compression of columns; calculation of the load a column is able to carry; compression members; bending; shear buckling of flat and curved sheets; torsional modulus of rigidity; torsional instability of open-section columns; and computation of the allowable failing stress for a column subject to failure by twisting.

PRINCIPLES OF ENGINEERING ECONOMY. By Eugene L. Grant. 623 pages, 6 by 9 inches. Published by the Ronald Press Co., 15 E. 26th St., New York 10, N. Y. Price, $5.

With the present high wage and price levels, the economic aspects of engineering have become increasingly important. The new edition of a book on the fundamental principles underlying enginering economy, written as a text for engineering students, should therefore be of widespread interest, not only to students, but also to practicing engineers and production executives. In the present edition, the text has been largely rewritten with a view to improving the

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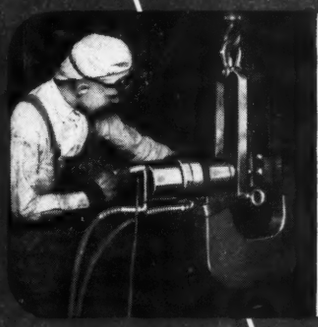

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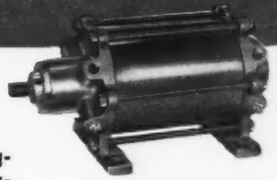

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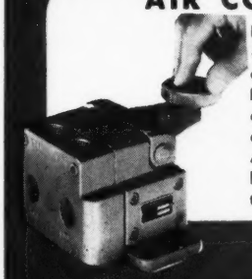

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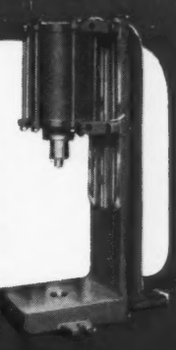

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presentation, and considerable new material has been added. Included in the new material are: Economy studies of prospective price changes and a chapter explaining and illustrating the basic principles that should enter into the consideration of income taxes in economy studies. The text is divided into four parts treating of the following subjects: Planning Economy Studies to Solve Engineering Problems; Interest—the Time Element in Economy; Techniques for Economy Studies; and Getting Results from Economy Studies.

RESISTANCE WELDING — DESIGNING, TOOLING, AND APPLICATIONS. By Wallace A. Stanley. 329 pages, 8 1/2 by 11 1/4 inches. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $7.50.

The basic purpose of this book, as stated in the preface, is to point the way to more economical and efficient design and production of metal products. It is not meant to serve as a positive set of fixed rules or methods of procedure, but rather to aid designing, manufacturing, tooling, and welding engineers in developing their own ideas. The material presented reflects the experience of hundreds of shops. The book explains what resistance welding is; the equipment and materials used; and design, tooling, and production techniques that afford large savings in materials, costs, manpower, etc. Information is given on how to design for spot welding, projection welding, seam welding, and flash butt welding. The subjects of tooling, handling, and materials control for resistance welding operations are also discussed. Over 700 photographs and line drawings show applications of the process in a wide variety of fields.

METALS AND ALLOYS. 214 pages, 5 1/2 by 8 1/2 inches. Published by the Chemical Publishing Co., Inc., 26 Court St., Brooklyn 2, N. Y. Price, $5.

The composition of approximately 4600 alloys used in the various industries is listed in this reference book intended for metallurgists, engineers, chemists, and users, buyers, and salesmen of metals, alloys and metal products in general. The first column of the tables contains an alphabetical list of the alloys, arranged by trade names or in case there is no trade name, by properties or uses. The other columns list the percentages of the various constituents of the alloys.

The alloys covered are those usually regarded as non-ferrous, and are limited to those containing not more than 50 per cent of iron. Alloys listed in the previous edition that are known to no longer be manufactured have been omitted, as is the case with a number of aluminum alloys, and an effort has been made to include all the new alloys, the aim being, of course, to make the list as complete as is reasonably possible.

WINDING ALTERNATING-CURRENT MACHINES. By Michael Liwschitz-Garik, assisted by Celso Gentilini. 766 pages, 6 by 9 inches. Published by the D. Van Nostrand Co., Inc., 250 Fourth Ave., New York 3, N. Y. Price, $8.50.

What is probably one of the most comprehensive treatises ever published on the winding of alternating-current machines is presented in this book, which should be useful not only to winders and repairmen, but also to designers of electric machines. This is the first book on the subject that covers completely lap windings, as well as wave windings. It describes new developments in integral-slot, fractional-slot balanced, and fractional-slot unbalanced lap and wave windings. A great number of working diagrams are given in order to facilitate the winder's work. Material is also presented on multi-speed windings, single-phase windings, reconnecting windings and methods of locating faults in windings.

METAL FINISHING GUIDEBOOK-DIRECTORY (1950). 488 pages, 5 by 7 3/4 inches. Published by Metal Finishing, 11 W. 42nd St., New York 18, N. Y. Price, $2.50.

The nineteenth annual edition of this reference manual contains a vast amount of information on electroplating, cleaning, polishing, buffing, and related subjects. In the engineering section of this edition will be found new data on corrosion-proofing plating equipment and information on the important problem of adequate disposal of toxic wastes. Modern applications of automatic plating, polishing, and buffing machines are described, as well as recently developed testing techniques now in use in the plating laboratories. The directory section tells where the various materials and equipment required can be purchased.

PROBLEM LAY-OUTS FOR TECHNICAL DESCRIPTIVE GEOMETRY. By B. Leighton Wellman. Published by the McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, N. Y. Price, $2.75.

This manual supplements the author's previous book "Technical Descriptive Geometry," published in 1948, and has been prepared to facilitate the working out of problems given in that book. It contains a series of large-scale problem lay-outs, each of which accurately duplicates the conditions stated in the correspondingly numbered text problem. The complete set of problems comprises 108 sheets. It is believed that these lay-outs cover all topics essential to a complete and well balanced course in descriptive geometry. Eight blank sheets are included for special problems that the instructor may wish to assign.

S A E AUTOMOTIVE DRAFTING STANDARDS (SP-66). Published by the Society of Automotive Engineers, Inc., 29 W. 39th St., New York 18, N. Y. Price, $3 to members; $6 to non-members.

A unified drafting practice that will cut costs, time, and effort in the drafting-room is set forth in this new S A E publication. One section—on fundamentals—includes drawing forms, lines, lettering, sectioning, projection, dimensioning, tolerances, threads, revisions, and checking. Other sections cover springs, surface finish, and chassis frames. These standards are published in loose-leaf form, but a three-ring binder is available at an additional cost of $2.

ASME MECHANICAL CATALOG AND DIRECTORY (1951). 645 pages, 8 1/2 by 11 1/4 inches. Published by the American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N. Y.

The fortieth annual volume of this combined catalogue and directory of industrial equipment and supplies in the mechanical engineering field covers 6500 products made by 4600 manufacturers. The catalogue section, as in past editions, illustrates and describes hundreds of items used by industry in manufacturing products and maintaining its plants. The directory contains a classified list of the equipment, machinery, and supplies listed in the catalogue pages, and gives the names and addresses of the manufacturers of each product. The third section of the book comprises an alphabetical list of trade names of the products listed.

BIBLIOGRAPHY ON NON-METALLIC BEARINGS (No. 6). Published by the Engineering Societies Library, 29 W. 39th St., New York 18, N. Y. Price, $2.

This is an annotated bibliography of 101 selected references to the literature of the last twelve years covering all aspects of non-metallic bearings, such as their manufacture, design, properties, wear, lubrication, performance, testing, and applications. The applications include automatic presses, agricultural machines, rolling mills, marine propeller shafts, railway-car axle bearings, etc.

HEAT-TREATMENT AND PROPERTIES OF IRON AND STEEL. By Samuel J. Rosenberg and Thomas G. Digges. 33 pages, 6 by 9 inches. Published by the National Bureau of Standards, and available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price, 25 cents.